# INFANT FEEDING

ROYSTER

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*3·5 per cent* instead of 3.5 ounces.

# A HANDBOOK
OF
# INFANT FEEDING

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BY

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TO THE
OVERWORKED AND UNDERPAID GENERAL PRACTITIONER WHO MUST OF NECESSITY BE NOT ONLY THE FAMILY PHYSICIAN BUT THE ALL-ROUND SPECIALIST THIS VOLUME IS AFFECTIONATELY DEDICATED

# PREFACE

THE idea of this little book was suggested to me as a result of consultation on feeding cases with many general practitioners. There is very little in it that cannot be found in most standard works, but in order to gain the necessary information the busy practitioner must spend much time reading many pages. Of necessity, most of the infant feeding is conducted by the family physician and it is a source of regret that many of these cases are handled in an unscientific manner.

The purpose of this book, then, is to furnish the essentials and only the essentials of infant feeding in a compact and succinct form.

The desirability of expressing the elements which go to make up the infant's dietary in the form of approximate percentages has been emphasized. It is not claimed by any advocate of this method of expression that it does more than approximate accuracy. To attain an accurate percentage would require the services of an expert chemist in a well regulated laboratory. The exact composition of each quantity of milk would have to be determined and the ingredients combined by weight and not by volume. This is, of course, impracticable. The value of the percentage method of expression lies in the

fact that it enables us to reduce or increase the various food elements with approximate accuracy in accordance with the needs of the infant.

The author realizes the fact that the book contains many imperfections, and that the specialist in diseases of children will find nothing in it new or original, but he hopes that those into whose hands it may fall will remember the purpose of the book and the needs of those for whom it was written, and that it may not be viewed with a too critical eye.

The works of many leading authorities on infant feeding have been consulted and quoted liberally and without reserve and to these the author hereby makes public and grateful acknowledgment.

To his friend, Dr. John Lovett Morse, who has so kindly contributed the very valuable chapter on stools the author desires to express his sincere gratitude.

To Mrs. A. T. Robertson, his secretary, the author acknowledges a large debt for the preparation of manuscript and reading of proof.

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# INFANT FEEDING

## CHAPTER I.

## INTRODUCTION.

THE study of dietetics has occupied a very much larger place in medical literature during the past twenty-five years than in any other period of medicine. The larger portion of this work has related to the feeding of infants; indeed, to the careful and scientific investigation of the relation of certain food elements to the infant economy is due the wider interest in dietetics in general. The investigation of infant feeding along scientific lines was very recently a pioneer work, and many important discoveries have been made which have revolutionized the subject. Almost as soon, however, as a new discovery was made or emphasis was placed on a certain food element there immediately sprang up, at least among the general practitioners of medicine, "a new method of feeding infants." This is most unfortunate, because there is no such thing as a "method of feeding infants" beyond the two well recognized methods of breast feeding and artificial feeding. In the one we have nature's method, which is the best; in the other we have the artificial method which we are compelled to use from time to

time when called upon to supplement or entirely supplant maternal nursing.

The great importance of this subject can be realized only when we consider a few statistical facts. Statistics as we know are proverbially misleading, proving usually what is the wish of the compiler; however, only through these means can we make comparisons. The percentage of children dying during the first two years of life has been variously estimated and although these estimates are far from being accurate they bring us to two very important and shocking conclusions:

First, that the mortality among children during the first two years of life is so far out of proportion to the normal death rate at all other ages that we must feel that something is radically wrong.

However startling this may be, the second fact is still more striking and that is that the vast majority of children dying during the first two years of life are bottle fed babies. Statistics differ, but after studying a large number of them and taking into consideration the conditions surrounding each particular set, I am convinced that the ratio is probably only one breast fed baby in every twelve deaths. It must not be inferred from this that artificial feeding *per se* is the cause of the large number of deaths at this age, for we must also take into consideration certain physical and economic factors which are co-active in causing the cessation of breast feeding and thereby contribute to the excessive mortality. There are, for instance, climatic

conditions which either in themselves produce the condition known as "summer diarrhea" (heat stroke theory), or under whose influence certain bacteria develop which cause the diarrhea. The latter theory is more than likely correct. ("Infectious Diarrhea.")

Yet I am certain that very many unnecessary deaths occur from improper feeding alone. We are brought to the unavoidable conclusion that an intensive study of infant mortality must begin with the question of artificial feeding. Moreover, this problem is essentially one for the general practitioner in medicine for undoubtedly upon him rests the burden of feeding the vast majority of infants.

It is seldom that we can improve upon nature. Nature has supplied the infant with a food which is sufficient for its needs at least during the greater part of the first year of life. This is mother's milk intended for the baby and supplying all the elements necessary for heat production and tissue building during this period, in a solution that is adaptable to the processes of infant digestion. No laboratory method can combine these elements so that they will be assimilated to the same extent as the natural product. Aside from this, nature supplies an indefinable "something" which specifically influences the young of the same species; whether this is an as yet undiscovered secretion of the mammary glands or the absorption of the secretion of some other gland of the body, we do not know. This indefinable something not only aids the infant in digesting the mother's milk but apparently pro-

tects it against the invasion of infection while it is being breast fed. In the light of these observations, no argument is necessary to make us use every endeavor to keep the child at the breast as long as is practicable, and during certain acute illnesses to supply human milk from another source at any cost. One of the most valuable assets in the child life of any community is a wet nurse register which may be established under conditions outlined by several observers. When it is not possible to use maternal feeding exclusively, or to substitute a wet nurse, we may resort to mixed feeding because even a very small amount of human milk will cause the infant to assimilate a modification of cow's milk very much better.

When it is finally determined that the continuation of breast feeding is impracticable, resort must be had to artificial methods which may be employed to supplement or supplant maternal feeding. The term "artificial feeding" today is practically synonymous with feeding by means of modified cow's milk. Much error has arisen in the minds of both the laity and the profession as to the true significance of this term. This error is due to ignorance of the facts, as evidenced by the frequency with which we hear from both physicians and mothers the expression, "the baby has been tried on modified milk and cannot take it."

"Modified milk" means simply cow's milk diluted, and usually some carbohydrate is added. Obviously success in feeding children on modified milk

depends on the proper dilution, for it is evident that if we take a child of three months and feed that child on a modification consisting of two-thirds cow's milk and one-third water without due regard to the addition of carbohydrates or other ingredients, we have a modification which is based on error, consequently it could not be expected to meet the requirements of the case. Whereas, if we first ascertain the approximate percentage of various ingredients which a child of this age is likely to assimilate, we may then anticipate a successful handling of the case. For many years, and even too often at the present time, proportions of various resources are used empirically and guess work plays a very important part in their employment and arrangement. Fortunately for the infant, through increasing knowledge, there has developed a more definite and scientific procedure by which we are enabled to adapt the various food elements to the requirements of the individual infant. Regardless of how the infant is fed, whether on simple dilutions of whole cow's milk or by the use of so-called top milk, or by means of cream, milk and water, the physician should always be able to state, at least approximately, the percentage of fat, carbohydrate and proteid which is given the infant in twenty-four hours, for only by this means can be determined, and by an intelligent examination of the stools, the amount of vomiting, etc., what element is causing trouble and thereby be enabled to adjust accurately the amount of the particular element.

I wish to urge, therefore, very strongly the feeding of infants in terms of definite percentages of the various elements. In order to do this, the physician in charge must accustom himself to thinking in percentages rather than in quantities. The complaint is frequently made that the so-called percentage method entails too much trouble and requires too much mathematics. On the contrary, I hope to demonstrate that it is a very simple procedure.

The average milk from a herd of cows is usually taken as —

| Fat | Sugar | Proteid |
|---|---|---|
| 4 | 4.50 | 3.20 |

while that of human milk is —

| Fat | Sugar | Proteid |
|---|---|---|
| 4 | 7 | 1.50 |

It was first supposed that cow's milk so diluted and added to as to make it conform as nearly as possible to the percentages of human milk was all that was necessary. It was very soon discovered that such was not the case since there is a very great difference in the infant's power to digest the elements in cow's milk and those in human milk. Cow's milk is suited to the requirements of the calf whose digestion is much more powerful than that of the infant. In fact, in a very short time after birth the calf is able to digest hay, grass and other substances in addition to or in place of its mother's milk. The human infant requires not

only a different proportion, but also that indefinable something to which we have already alluded which is supplied by the human mother and not by any other animal. Moreover, as a rule, the baby can take smaller proportions of the same elements in cow's milk than in human milk and, generally speaking, can assimilate a higher proportion of casein than it was once thought and can take smaller proportions of fat. Therefore, a complete rearrangement is necessary in which we are to be guided by the study of the child's nutrition, weight and the examination of stools. In order to render the elements of cow's milk more digestible, we make use of various substances which the modern student of child dietetics refers to as "resources."

## CHAPTER II.

## RESOURCES.

THE three principal resources on which we must rely in feeding infants are those contained normally in cow's milk, namely—fat, carbohydrate (sugar), and proteid. Many methods have been devised for the more or less definite proportioning and rearranging of these elements, such as simple dilutions of whole milk and so-called top milk in which we use either the top third, containing 10 per cent fat, or the top half, containing 7 per cent fat, of a quart bottle which has been allowed to stand long enough for the cream to rise (gravity cream); and by means of cream and skim milk, in which the upper six ounces of a quart bottle are removed by means of a dipper, thus giving us a 16 per cent cream, that is, a cream containing 16 per cent fat. The remainder of this bottle is skim milk.

For many years, the proteid received most of the blame when modified milk did not agree with the infant, consequently an effort was made to reduce the proteid to an infinitesimal percentage. As time went on and our knowledge increased, it was discovered that proteid did not cause the harm it was thought and fat caused more harm than was originally supposed. Then followed the period of

high proteid and low fat proportions. Close upon this observation came the discovery that sugar intolerance was very quickly established in many children, consequently sugar came in for its share of blame. We recognize today, however, that an intolerance may be established when any food ingredient is used unwisely, hence the necessity for adjusting every food formula to the peculiar needs of the individual infant.

**Fat.**—Fat is primarily a heat producer and the greatest need during early infancy. The fat of cow's milk is more difficult to digest than that of human milk, consequently its administration should be handled carefully, beginning with a low percentage and increasing very gradually until a safe percentage is reached. From one to three per cent forms a safe amount for the average healthy baby. Under no circumstances do I ever allow myself to use more than four per cent and this exceedingly rarely. I believe that recent writers attribute more harm to fat than it deserves, although I admit that it must be guarded more carefully than any of the elements. It has been popularly believed for a long time that fat was laxative, but if given in too large proportions experience teaches us that soap is formed and the waste product is excreted as a hard, chalky fecal mass, thus producing constipation and indigestion. While proteids do not cause the amount of trouble that was formerly supposed, a proteid intolerance is frequently established, and I am not willing to use an excessively high proteid

content in the baby's food, certainly not in the care of a young healthy baby.

The principal difficulty in the protein metabolism is the strain on the excretory system. A proteid indigestion is more difficult to recognize than that caused by either fat or sugar, but for practical purposes a careful examination of the stools will determine that the fat is not at fault and if we know that we have a moderate sugar percentage, we can safely assume that proteid indigestion is causing the trouble. The general value of the high percentage of proteids is in those cases of fat and sugar intolerance, especially of the subacute and chronic type so frequently found in late infancy (Finkelstein type). In these cases the higher proteid percentage is not only well borne, but is distinctly advantageous from a therapeutic standpoint. The exact form of proteid that gives the best result has not yet been determined. In the gastric type of indigestion we find proteid of great value. It is wiser, however, in this type to give it in the form of whey or soluble proteid to the exclusion of casein.

**Sugar.**—The majority of children whose feeding has been started wisely thrive admirably on milk sugar, which is a normal content of both human and cow's milk, during the whole of infancy, and the milk sugar of commerce mixes well with the sugar already in every simple milk mixture. There are times, however, when the child does not thrive on what appears to be a perfectly rational

formula with milk sugar. In these instances it will be found advisable, for some unknown reason, to change to malt sugar, or rather the mixture of dextrin and maltose which is the most available malt sugar on the market. Whether this is due to the simple change of taste, thereby causing a stomachic effect, or whether there is a chemical reason we are not yet prepared to state.

There are instances of milk sugar indigestion supposed to be due to fermentation but since there is great discussion as to the relative fermentability of milk and malt sugar we are not quite sure on this point. Of one thing I am thoroughly convinced, that is, that higher percentages of fat can be assimilated by the average infant in the presence of malt than in the presence of milk sugar. Whether this is an advantage or not must be determined by the individual case. Malt sugar has been of greater use in my experience after acute conditions than in chronic.

**Starches.**—The routine use of starches in infant feeding is not necessary. Their food value is very slight, hence the main indication for their use is in breaking up or preventing, through purely mechanical action, the hard casein curds. It requires a definite amount of starch to accomplish this. It is desirable, therefore, to use a starch solution to the amount of 75 per cent of total twenty-four hour quantity, and not of the amount of cream and skim milk, although this has frequently been done. As a general rule, starch is not added to the

food of young infants, yet it has been proven of late that young infants digest starch as well as older ones do. It is added more frequently to the food of older babies because it is found that they most frequently need it. It is contended by some observers that starch directly influences the absorption of sugars.

**Alkalies.**—The action of alkalies is not definitely known. It is very generally accepted that they delay the process of coagulation of casein and by so doing promote the more rapid emptying of the stomach thus allowing most of the milk to pass into the intestines from the stomach before the coagulation occurs. If we accept this view, they would seem more valuable in gastric than in intestinal indigestion and should be used in definite proportions to the amount of cream and milk and not to that of the total quantity. According to some, they increase the flow of hydrochloric acid and delay the pyloric opening and consequently delay the emptying of the stomach and promote the saponification of the fat. The routine use of alkalies is not a necessity. Lime-water, bicarbonate of soda and sodium citrate are used by various investigators, but lime-water at the present moment remains the most popular.

**Peptonization.**—A number of years ago, peptonization played a very important part in infant feeding, but with increased knowledge of infant metabolism it has become possible to correct the disproportions of diet by changing the proportions of

food elements. There still remains a limited number of cases where peptonization for a short time does good. When used at all, it is well to start with complete peptonization and then gradually decrease both the amount of peptonizing material and the time of peptonization until we have returned to the raw product. It is a great mistake to feed predigested food for too long a time because in this way the digestive power of the infant is decidedly lowered.

**Whey.**—Whey forms a valuable and often unappreciated addition to our armamentarium. In milk there are two principal forms of protein; casein, which is largely insoluble, and the soluble or whey proteid. It is frequently desirable to use a soluble proteid to the exclusion of casein or in addition to it in larger proportion than would occur in the amount of skim milk used. We make use of whey alone for longer or shorter periods, or as a diluent in the milk modification, which gives us a large proportion of the soluble proteid and a small proportion of casein (split proteid) thus enabling the infant digestion to gradually take care of the casein. It is especially valuable after acute indigestion in aiding the patient to return to a stronger milk formula. The ingredients of whey vary somewhat according to whether we use skim milk or whole milk in its preparation, the skim milk furnishes us no fat in the resulting whey; the whole milk giving approximately .90 per cent.

**Acids.**—For all practical purposes the only acid

used in infant feeding is lactic acid, which in the form of buttermilk is at times a very useful aid, made either from whole milk or fat free (skim) milk as may be indicated. This forms a connecting link in milk composition between whey and precipitated casein. In making buttermilk any strain of Bulgaricus may be used if lactic acid is our object, but if the buttermilk is intended as a vehicle for the bacillus Bulgaricus, there are very few strains that are of value which are obtainable in this country. In the latter case, it is probably preferable to administer the bacilli in solution separately.

**Precipitated Casein.**—Precipitated casein has recently been given marked prominence through Finkelstein and his students. I do not think the indications for its use are altogether clearly understood in spite of many authorities who hold contrary opinions, but undoubtedly in those cases of extreme carbohydrate intolerance, and especially where a fat intolerance exists at the same time, precipitated casein becomes a very valuable agent. This is especially true in the chronic cases of marasmus in the older infants of the Finkelstein type in whom is almost always a carbohydrate and fat intolerance. There is also a limited field of usefulness in gastric indigestion in younger children.

**Condensed Milk and Proprietary Foods.**—Personally, I rarely if ever find indication for either of these resources. In traveling long distances with an uncertain milk supply on the journey, I think

one is justifiable in using condensed milk, but even here, where milk laboratories, or at least certified milk, can be found in almost all large cities, assuring the preservation of milk for at least three or four days under proper conditions of handling, it would seem that their field of usefulness is again limited. The apparent tolerance of infants to condensed milk "when other forms of modification have failed" is undoubtedly dependent on the low fat and protein plus a tolerance for cane sugar. In order to prove this, I have frequently given a child who seemed to furnish indications for condensed milk, a formula of modified cow's milk exactly corresponding with the condensed milk dilution and found that they did equally as well. Alluding to proprietary foods, I, of course, allude to those which are used with milk dilutions. These are undoubtedly dependent for their value on the malt sugar contained. The very wide use of both condensed milk and certain proprietary foods shows to my mind at least, as stated above, very clearly that infants have a higher tolerance for various sugars than we have hitherto supposed and also suggests the very important caution that too high percentage of sugar may give rise very quickly to sugar intolerance which, when once established, is frequently very difficult to overcome.

**Sterilization and Pasteurization.**—Primarily both of these procedures are useful where the purity of the milk supply is in doubt, and when this is the case, I invariably pasteurize or boil the milk.

Where pure milk is assured, neither is necessary. Occasionally, however, in the case of the hard casein curds in the stools, with or without colic, boiling for even a limited period seems to inhibit their formation. The digestibility of the milk through these processes does not seem to be impaired, but in some instances seems rather to be increased. In other cases where it is deemed advisable to use heated milk for any long period of time scurvy must be carefully watched for and in order to prevent this orange juice may well be administered earlier than usual.

## CHAPTER III.

## GROWTH AND DEVELOPMENT

GROWTH and development are dependent on the quality and quantity of the food the infant receives and probably more on the former than on the latter. A steady increase in weight is a desirable and essential evidence of proper nutrition and yet one must not rely on this evidence alone. The birth weight of the average child is approximately seven and one-quarter pounds, females slightly below this and males slightly above. At five months the average child doubles its birth weight and at twelve months the birth weight is almost trebled. At the end of the second year, the average child weighs twenty-six pounds and at the end of three years thirty-one pounds. It must be remembered that these are averages and must not be regarded as absolute figures. A child weighing only six pounds at birth is well developed if it weighs eighteen pounds at the end of the first year, and a child weighing ten pounds at birth would be expected to weigh thirty pounds at the end of the first year. A child small at birth increases at a normal rate for the first six months. It is apt to gain more rapidly than the child who was heavier, at birth, during the second six months and it is not

infrequent to find a child small at birth weighing as much at the end of six months as a child of average weight. Also, a child that is abnormally heavy at birth is not as apt to reach a treble weight at one year as is the average child. The average weekly gain of a breast fed baby is larger during the first six months (6 oz.) than the second (4 oz.) and a breast fed baby uniformly maintains a heavier weekly average than the bottle fed baby. This does not apply, however, to infants who have had long, exhausting illness for in these cases the average weekly gain is apt to be excessive for a while. Barring such cases as these a child on the bottle who gains excessively over the average is in danger of a general upset from the overtaxing of the digestion and I have repeatedly seen a disturbance of the digestion predicted by a sudden rapid gain in weight. This fact emphasizes the importance of occasionally checking the feedings by an estimation of the caloric values of food.

The length of a child bears a more definite relation to its age than does its weight. At birth, the average child measures 20½ inches in length, gains eight inches during the first year and 4 inches the second year. These figures are very nearly constant. A fat infant is much desired by the average mother, but fatness in an infant and proper nutritional development do not necessarily accompany each other. Especially is this true of infants fattened by means of certain proprietary foods which are rich in sugar and starch. It is in just such cases

as these that rickets and scurvy develop most frequently. Therefore, as stated, weight alone should not be our guide as to the state of nutrition, particularly is this true in the case of artificially fed infants.

Other points of observation are the time of closure of the fontanels, delay in their closure being due most frequently to rickets, also to hydrocephalus, although the latter is not a nutritional disorder. Cranio-tabes is also to be looked for as indicating both syphilis and rickets. The degree of firmness of the flesh of the infant is obvious to the practiced observer at the first examination and tells us much concerning the lack of proper food. The study of the head should furnish us the first warning of approaching rickets and call for an immediate change of diet. The attendant physician should be constantly on the watch for epiphyseal enlargements and the development of rachitic rosary. The shape of the head also furnishes us a useful guide as to nutrition, as the early change in contour of the cranium should immediately put us on our guard, while localized sweating of the head means almost always the incipiency of rickets. It is astonishing how frequently the development of scurvy escapes the notice of the attending physician. Scurvy is essentially a nutritional disturbance in the artificially fed and usually arises during a prolonged use of condensed milk or of those proprietary foods which are not mixed with fresh cow's milk. I have never seen scurvy develop in the

course of feeding on boiled milk though whenever this is used the attending physician should be constantly on his guard. If boiled milk is necessary for any prolonged period, it is wise to begin the use of orange juice early. Therefore, in considering the proper amount of growth and development we should take into account increase in weight, average gain in length, degree of firmness of subcutaneous tissue, size of fontanels and the presence or absence of the signs of rickets or scurvy.

## CHAPTER IV.

## THE STOOLS IN INFANCY.

By John Lovett Morse, M.D.

IT hardly seems necessary to emphasize the importance in relation to both diagnosis and treatment of the examination of the infant's stools in disturbances of digestion. It seems self-evident that the treatment cannot be carried out properly unless the cause of the disturbance is known, and in no other way can the cause be as accurately and as quickly determined as by the examination of the stools. The examination of the stools is, nevertheless, unless I am much mistaken, often entirely neglected, or, if not neglected, carried out hastily and imperfectly. I am sure the stools would be examined more often and more carefully if the importance of the examination were thoroughly appreciated.

The character of the stools depends primarily on the composition of the food and digestive power of the individual infant and the amount and rapidity of the absorption of the products of digestion, the latter being dependent, in turn, upon the rapidity of the passage of the intestinal contents through the intestinal canal. The character of the stools is also modified materially by the intestinal bacterial flora of the individual infant. The influence which this

flora has depends to a large extent on the digestive power and rapidity of absorption, as the bacteria have much more opportunity to act when the digestive powers are feeble and the absorption slow. The bacterial flora depends in a great measure, moreover, on the nature of the food. It is evident, therefore, that it is more difficult to draw conclusions as to the processes going on in the digestive tract from the examination of the stools than would at first appear. It is possible in most cases, however, to determine whether any given food element is properly digested and assimilated or not, and in many diseased conditions to tell what element is at fault. Experience shows, moreover, that diminishing or withdrawing the element which is not being digested has an immediate effect on the character of the stools and upon the course of the disease.

The stools differ normally according as to whether the infant is taking human milk or cow's milk, and whether starches or other carbohydrates are added to the cow's milk.

**The Stools of Breast Fed Infants.**—The breast fed infant has, during the first few weeks or months of life, three or four movements daily of the consistency of pea soup, of a peculiar golden-yellow color, with a slightly sour or aromatic odor, and with a slightly acid reaction. The number of stools diminishes later to two or three in the twenty-four hours and the consistency becomes more salve-like, the other characteristics remaining the same. The

golden color is due to bilirubin, which passes unchanged through the intestinal tract because of the rapidity of the passage, the relatively low proteid content of the milk and the low reducing power of the infant's intestine. The odor is due to a combination of lactic and fatty acids. The acid reaction is due to the relative excess of fat over proteid in the milk.

It is not uncommon, even when babies are doing well on the breast, for them to have a large number of stools of diminished consistency and of a brownish color. In such instances, examination of the breast milk usually shows that the proteids are high. It is also not unusual to find numerous soft fine curds and sometimes mucus in the stools of healthy breast fed babies. While such stools are undoubtedly abnormal, it is unwise to pay too much attention to them if the baby is gaining and seems well. The breast fed infant will often go weeks or months without a normal stool and yet thrive perfectly, while if it had such stools while it was taking cow's milk it would not thrive and would show distinct evidences of malnutrition. It is, therefore, unwise to wean a baby simply because the stools are abnormal, if it is doing well in other ways.

**The Stools of Infants Fed on Cow's Milk.**—Infants that are thriving on cow's milk mixtures have, in my experience, fewer movements in the twenty-four hours than breast fed babies and the movements are of firmer consistency. Slight con-

stipation is not uncommon after the first few months and it is not of pathological significance. The color of the stools is a light yellow, probably because of the relatively larger amount of proteid, and because some of the bilirubin is converted into hydrobilirubin. When the relative proportions of fat and proteids in the mixtures are approximately those of breast milk, the color and reaction of the stools are essentially the same as when the infant is taking breast milk. When infants are given whole cow's milk or simple dilutions of cow's milk, so that the proteids are equal to or greater than the fat, the odor is slightly modified toward the fecal or cheesy because of the action of the bacteria on the casein. The reaction becomes alkaline for the same reason.

**Skim Milk Mixtures.**—When infants are fed on skim milk or on mixtures very low in fat and high in proteids, the stools have a slightly brownish-yellow color, a slightly cheesy or foul odor, and a strongly alkaline reaction because of the longer stay of the casein in the intestines and the consequently greater opportunity for bacterial action and for the change of bilirubin to hydrobilirubin. In some instances, the stools have a peculiar salve-like appearance like those from buttermilk.

**Whey and Whey Mixtures.**—When infants are fed on whey or whey mixtures low in fat, the stools have essentially the same characteristics as those from skim milk, except that they are usually brown-

er. Whey has a laxative action in many instances and sometimes has to be omitted for this reason.

**Starch Mixtures.**—When starch is added to cow's milk mixtures, the color of the stools becomes more distinctly brownish and the reaction tends toward the acid. The odor is more aromatic. The character of the starch has, in my experience, but little effect on the number of movements, in spite of the common belief that barley starch is constipating and oatmeal starch laxative. The action, if there is any, seems to vary with the individual infant. In this connection it must not be forgotten that most starch flours contain small brownish specks which are the remains of the husks. These specks pass through the gastro-intestinal tract unaffected and appear in the stools.

**Malt Sugar Mixtures.**—The addition of malt sugar to cow's milk mixtures changes the color of the stools to a distinct brown, tends to make the reaction acid and to increase the acidity of the odor. Malt sugar usually has a laxative influence, but sometimes constipates. When malt sugar or the malted foods are given without milk the stools are dark brown, sticky, acrid in odor and acid in reaction.

**Buttermilk and Buttermilk Mixtures.**—The stools of infants fed on buttermilk and buttermilk mixtures are of a peculiar, shiny, salve-like appearance, grayish-brown in color, alkaline in reaction and have a very characteristic odor.

**Animal Food.**—When beef juice or broth are

added to the infant's diet the color is changed to brown, while the odor becomes fecal and the reaction alkaline from the action of the bacteria on the proteids.

**The Starvation Stool.**—The starvation stool is made up of bile, the intestinal secretions and bacteria and resembles the meconium. It is usually small, sometimes constipated, sometimes loose, brownish or brownish-green in color and has, as a rule, a stale odor like that of starch or paste. In some cases it has the odor of acetic acid as the result of the action of micro-organisms.

**Reaction of the Stools.**—The reaction of the normal stool depends on the relation between the fat and the proteids in the food. When there is a relative excess of fat the reaction is acid; when there is a relative excess of proteid the reaction is alkaline, the reaction depending, in the one case, on the products of the decomposition of fat, in the other, on the composition of the decomposition of proteids. The carbohydrates have no effect on the reaction of the normal stool. When the carbohydrates are in excess, or when there is fermentation of the carbohydrates as the result of bacterial action, the acidity of the stools is markedly increased. Stools which irritate the buttocks are invariably acid in reaction, and in most instances this excessive acidity is due to the decomposition of carbohydrates. Frothy stools are usually acid in reaction, and due to the same cause, but sometimes the frothiness is caused by gases formed during the

decomposition of proteids. The reaction of the stools is, however, of comparatively little importance from the clinical side. It is best tested by placing wet red or blue litmus paper on, not in, the stool.

**Color of Stools.**—The normal variations in the color of stools according to the composition of the food have already been mentioned. Abnormalities in the color are very common. The color of the stool must not be judged from the outside, as it may change very rapidly from drying and exposure to the air. The stool must be broken up and smoothed out and the inside examined.

*Green.*—The most common abnormal color is green. The shade of green may vary from a very delicate light grass-green to a dark spinach-green. In a general way, the darker the green the greater its significance. A very light grass-green color in a stool which is otherwise normal is of no practical importance. The change from yellow to green after the stool is passed is not abnormal. The green color is, in the vast majority of cases, due to the change of bilirubin to biliverdin. There is much doubt as to the cause of this change. It is probable that it may be due to either excessive acidity or alkalinity of the intestinal contents or to the presence of some oxidizing ferment. The green color is not characteristic of any special type of disease. In some instances it is due to the action of the bacillus pyocyaneus. If it is due to bacterial action, the addition of nitric acid decolorizes the

stool. If it is due to biliverdin, the action of nitric acid gives the characteristic colors of Gmelin's test.

*Gray.*—The next most common abnormal color is gray. This is due, as a rule, to the absence of bile and the presence of some form of fat in the stool. It must be remembered, however, that there may be bile in the stool even when it is gray, the bile pigment being in the form of the colorless leucohydrobilirubin. It is never safe, therefore, to conclude there is no bile in the stool without a chemical examination. The easiest and most satisfactory test is that with corrosive sublimate. When the stools are gray at birth, or become so within a few days after birth, the lesion is usually a congenital obliteration of the bile ducts. When the gray color appears later, and especially when it is associated with large amounts of mucus, the trouble is usually in the duodenum.

*White.*—The white stools are due to the presence of undigested fat in the form of soaps. These may be soft, looking much like curdled milk, or more often, hard and dry, resembling the stools of a dog which has been eating bones.

*Black.*—The black stool, while in rare instances due to the presence of changed blood, is usually due to the action of some drug, ordinarily bismuth, sometimes iron. In this connection, it is well to remember that when there is no sulphuretted hydrogen in the intestine bismuth may pass through the intestinal tract without changing the color. The administration of a grain or two of sulphur in the

twenty-four hours will turn the stools black. Whether or not this is of any advantage is questionable.

*Blue.*—The stools are sometimes of a slaty-blue color. This color is due to some change in the bile pigments and is of no more significance than the green.

It is very common to see a pink stain on the diapers about a stool which is otherwise normal or nearly so. This pink stain is of no especial significance and is due to some unknown change in the bile pigment.

**Abnormal Constituents.—Curds.**—The most common abnormal constituents are curds. Judging from the literature of the subject, there is a great deal of confusion as to the composition and significance of the curds in infants' stools. The matter is, however, a simple one. There are two kinds of curds, one primarily composed of casein, the other composed mainly of fat, mostly in the form of fatty acids and soaps. The small amount of fat in the casein curds and the small amount of proteid in the fat curds are merely incidents. The casein curds vary in size from that of a bean to that of a pecan nut. They are usually white, sometimes yellow in color. They are firm and tough, cannot be broken up by pressure and sink in water. When placed in formalin they become as hard as rocks; they are insoluble in ether. The fat curds are small, varying in size from that of a pin head to that of a small pea. They vary in color from

white to yellow or green, according to the general color of the movements. They are easily broken up by pressure, and, when shaken up in water, tend to remain in suspension. They are soluble in ether to a considerable extent after acidification and are unaffected by formalin.

**Mucus.**—Mucus can be detected in small amounts under the microscope in the majority of normal stools, and is almost invariably present in abnormal stools. It is never present macroscopically in normal stools, but is very common in the abnormal. It does not denote any special form of disease, merely an excessive secretion of the mucous glands of the intestines from some cause. When thoroughly mixed throughout the stool it usually comes from the small intestine; when in combination with a clay-colored stool, from the duodenum; when on the outside of a constipated stool, from the rectum. Stools composed mainly or entirely of mucus and blood indicate either severe inflammation of the colon or intussusception. Undigested starch is often mistaken for mucus. They can be distinguished by the addition of some preparation of iodine, which stains the starch blue, but does not affect the mucus. The suspected material should be taken off the diaper in order to avoid possible confusion from the presence of starch on the diaper.

**Blood.**—Blood on the outside of a constipated stool indicates a crack in the anus. Blood mixed with mucus indicates either severe inflammation of

the large intestine or intussusception. Blood in infancy is seldom due to hemorrhoids.

**Pus.**—Pus indicates severe inflammation of the large intestine. It is usually not present early in the disease, but appears later on. When the infants survive the acute stage it persists into convalescence. Pus can be found with the microscope in nearly every case of inflammation of the colon, but it is of no special significance unless visible macroscopically.

**Membrane.**—Membrane indicates very severe inflammation of the large intestine and is rarely seen, the patients usually dying before membrane appears in the stools.

Other abnormal constituents are undigested masses of food, foreign bodies which may have been swallowed, and worms.

**Microscopic Examination of the Stools.**—The macroscopic examination of the stools affords data sufficiently reliable for clinical work in the great majority of instances. It may, however, lead to erroneous conclusions, especially with regard to the amount of fat and undigested starch. Fatty and starchy stools sometimes appear perfectly normal macroscopically and microscopic examination alone will prevent mistakes. It is advisable, therefore, in all but the plainest cases to examine the stools microscopically as well as macroscopically. The microscopical examination of the stools is not a difficult procedure and can be carried out in ten minutes or less by any one accustomed to it. Con-

trols of the microscopic examination by chemical examination of the stools have shown that it gives results sufficiently reliable for clinical purposes. A certain amount of experience is necessary, however, in order to recognize the normal variations in the microscopic picture. The stools normally show a certain amount of fat in some form or other, but never show unchanged starch. The chief difficulty in the microscopic examination is to learn to recognize the normal variations in the amount of fat.

The feces, if hard, are first rubbed up with a little water. Otherwise they are thoroughly mixed, and three small portions placed on a slide. The first is crushed out very thin under the cover glass and examined in the fresh condition. In this portion any undigested tissues or pathological elements, such as blood, pus, and eggs of parasites, can be differentiated. A preliminary estimation of the amount of neutral fat, fatty acids, soaps and starches may also be made.

The second portion is stained with Lugol's solution (iodine 2, potassium iodide 4, distilled water 100) and examined for starch. The starch granules stain blue or violet. Certain microbes also stain blue. These, the so-called iodophilic bacteria, are associated with faulty carbohydrate digestion and, when found alone without other symptoms, are suggestive of an early disturbance in the digestion of the carbohydrates. Before concluding that undigested starch is present, all possibility of

contamination with baby powders must be eliminated.

The third portion is stained with a saturated alcoholic solution of Sudan iii. The neutral fat drops and fat acid crystals stain red. Soap crystals do not stain with Sudan iii. After this specimen is examined and the microscopic picture is clear, a drop of glacial acetic acid is allowed to run under the cover of the glass, is thoroughly mixed in and then heated until it begins to boil. This process turns the soap into neutral fat and fatty acid which will appear as large stained drops and upon cooling crystallizes. They usually retain the red stain. Any increase in the amount of fat after the addition of acetic acid indicates the presence of a corresponding amount of soaps. If there are any fat drops visible after the addition of Sudan iii and before the addition of acetic acid, another specimen should be stained with a dilute solution of carbolfuchsin (carbolfuchsin sol. 1: water, 4 or 5). With this solution the neutral fat is not stained, while the fatty acids are stained a deep red and the soaps a dull rose-red. Without this stain it is impossible to distinguish neutral fat from fatty acids. An excess of neutral fat indicates that the digestion of fat is not carried on normally; an excess of fatty acids and soaps, that the digestion is normal, but assimilation is abnormal.

It is well to examine the specimen first with a low power objective and later with a No. 7 objective in order to bring out the detailed structure.

**Bacteriologic Examination of the Stools.**—Our knowledge of the bacteriology of the disturbances of digestion and of the various inflammatory diseases of the intestine is so limited at present that no conclusions of clinical importance can be drawn from the microscopical examination of the stools, the only exception being, possibly, the presence of large numbers of iodophilic bacteria, which, as already stated, point to the disturbance of the digestion of the carbohydrates.

**The Stools of Different Types of Indigestion.**—It may be well, perhaps, to sum up the characteristics of the stools in some of the more marked types of indigestion. The stools of the various inflammatory conditions are familiar to every one and hardly need further description.

**The Stools of Fat Indigestion.**—Undigested fat may show itself in the stools in the form of small, soft curds, by giving a greasy, shiny appearance to the stools or by giving a gray or white color. The small curds are, of course, easily recognized. The presence of undigested fat may be shown roughly by rubbing some of the stool on a piece of smooth soft paper. If there is an excess of fat, the paper will have, when dry, the appearance of oiled paper. When there is an excess of neutral fat the stools are often of a creamy consistency. If the fat is largely in the form of soaps, the stools are usually clay-like or very dry and crumbly. The reaction is highly acid; the odor rancid, like that of

butyric acid. Microscopically these stools show a large excess of fat in various forms.

**The Stools of Carbohydrate Indigestion.**—The character of the stools of carbohydrate indigestion depends on whether the disturbance is in the digestion of starch alone without bacterial action or in the digestion of either or both starch and sugar with bacterial fermentation. When the disturbance is solely in the digestion of starch and bacterial fermentation is not marked the stools are brown or golden yellow in color, and salve-like in consistency. They may, as already stated, appear macroscopically normal. In rare instances they are very dry and brittle. The reaction is acid. The odor is acid, the character of the odor depending on the form of acid present. The iodine test will often macroscopically show the presence of undigested starch. Microscopically these stools show undigested starch by the iodine test, and an excess of iodophilic bacteria. When bacterial fermentation is added to the disturbance of digestion of either starch or sugar the stools are loose, green and frothy. The reaction is acid from the presence of lactic, acetic and succinic acid. The odor is acid, the character of the odor depending on the form of the acid present. These stools often cause excoriation of the buttocks and genitals.

**The Stools of Proteid Indigestion.**—The presence of large tough curds in the stools is, of course, evidence of proteid, or rather casein indigestion. In general, however, the stools of proteid indiges-

tion are loose, brownish in color, alkaline in reaction and with a foul odor, the odor in some instances being fecal, in others cheesy, in others a combination of the two. The stools of proteid indigestion are more likely to show an excess of mucus both microscopically and macroscopically than are those of either pure fat or carbohydrate indigestion.

**Mixed Forms of Indigestion.**—Mixed types of stools as the result of mixed types of indigestion modified by bacterial fermentation and decomposition are far more common than the pure types alone and are often very difficult to interpret.

**Conclusions.**—It seems safe to draw the following conclusions regarding the examination of stools in infancy. The stools in infancy are not examined as often as they should be. The examination of the stools gives information regarding the digestive processes which cannot be obtained in any other way. Without such examination, treatment is always unscientific and often irrational. The macroscopic examination of the stools affords information of the greatest importance, but in many instances will lead to error unless the microscopic examination is also made. The microscopic examination is a simple one and requires but little time. The results obtained from it are, for practical purposes, as reliable as those obtained from the chemical examination.

## CHAPTER V.

## BREAST FEEDING

VERY few factors enter more strikingly into the success or failure of infant feeding than a right start. This applies both to breast feeding and artificial feeding, though, of course, to a less extent in the former than the latter.

For the first few days of the puerperium, as is well known, the mother's breast contains little or no milk. During this time the infant is not in need of food else nature would have provided food for it. The child sleeps almost constantly. Usually on the third day, sometimes on the fourth, and occasionally as early as the second day, the mother's milk begins to flow. This is the rule for primiparæ; in multiparæ, it may be present on the third day, especially in those women who have nursed a previous child well up into the later months of pregnancy. This makes no particular difference in the nursing of the new-born, though it is apt to give the mother trouble.

It is customary to begin children on six hour intervals for the first day or two at the breast and then shorten these periods to two or two and one-half hours. In referring to the intervals of feeding, it is well to count from the beginning of one feeding to the beginning of the next feeding. This

question of the interval of feeding has been much discussed of late and to my mind entirely needlessly. There are three criteria by which the interval is to be determined, namely, the vigor of the child, its capacity and the quantity of the mother's milk, this virtually resolves into the question of supply and demand. I do not think it is proper to follow fixed rules as is frequently done, in determining either the interval or the quantity of each feeding at the various ages. In the light of recent investigation through the experiments of Pisek and LeWald and others working with the serial radiographs it is found that children are as distinctly individual as to their stomach capacity and the time the stomach requires to empty itself as they are in other respects. For example, these experimenters have demonstrated the fact that children vary as to their stomach capacity as much as one or two ounces for a child of the same age and weight. The time required for the stomach to empty itself has also been proven to vary as much as the capacity, hence, generally speaking, the child itself must be our guide in both of these matters. I seldom feed a child oftener than every two and one-half hours, nor do I follow the other custom of four hour intervals as advocated so strongly of late unless I find a combination of a strong, lusty infant and a mother with an unusual supply of milk, the child possessing at the same time a capacity which will tide it over with comfort for that length of time.

Generally speaking, the child should be aroused at definite intervals rather than be allowed to sleep over unusual periods, for if too long an interval, under these conditions, is allowed to elapse, not only will the child probably overcrowd its stomach thereby causing regurgitation and subsequent indigestion, but also the mother is subjected to an unnecessary amount of discomfort from an overfull breast. Regular intervals of feeding are also necessary to maintain an even and steady flow of milk in the mother's breast. Within reasonable limits, therefore, with a healthy nursing baby and a mother who requires no particular amount of watching, the nursings will usually take care of themselves, the intervals being relatively shorter during the early part of infancy and gradually lengthening to the natural time of weaning. For the first three months, the baby usually nurses once between ten p. m. and six a. m., after this time no nursing is necessary between these hours. The question of the mother's food during the period of lactation has received an unnecessary amount of attention; good, wholesome, plain food and a sufficient quantity is all that is necessary. Since the mother's milk is primarily a secretion and only secondarily an excretion, food can influence the milk only in so far as it influences the general condition of the mother's nutrition. Whatever food is given, therefore, should be directed toward the mother's general welfare and not chosen with any specific idea of increasing the supply of milk.

Overfeeding on the part of the mother is apt to cause a milk too rich in fats and, to a less extent, in proteids, while lack of proper and well-regulated exercise will almost invariably produce a proteid indigestion, with colic, in the infant. As a rule, when an infant is suffering from either fat or proteid indigestion, it is manifested by the appearance of fat or casein curds in the stools, with colic, and it is best treated through moderate exercise of the mother.

Perhaps the most potent influence in milk production is the state of the mother's mind; a quiet, peaceful mind, free from undue worry, goes a long way toward the production of a sufficient supply of milk. On the other hand, constant worry, or a sudden mental shock is apt to give either a very poor grade of milk or a complete cessation of the flow. The best milk producer that I know of is the mouth of an infant. So strikingly is this the case that there are many instances of mothers nursing several infants at the same time. In fact, more than one case is on record of one woman nursing as many as five infants. I do not believe that any drugs have ever been proven of value in increasing the flow of milk, especially is this true of alcoholic and malt preparations.

We hope for something definite to develop through the use of the products of internal secretions of normal glands. Constipation in the mother is a constant source of disturbed lactation. This

constipation is far better regulated by diet and exercise than it is by drugs.

There are a few contra-indications to maternal nursing. Recent observers have demonstrated the fact that toxemia of pregnancy furnishes a striking contra-indication to nursing and wherever the mother has had a marked albuminuria with or without convulsions, the child should not be put to the breast until all traces of albumin have disappeared and then only with the utmost care and supervision. In the meantime, the mother's breast should be stimulated to secrete by means of a breast pump so that the child may yet receive its natural food. Open tuberculosis is, of course, a contra-indication which needs no argument; insanity also should lead us to interrupt the nursing, while sudden emotion such as fright and the like may furnish a contra-indication. Other causes of the sudden interruption of the secretion may arise temporarily, requiring the substitution of the bottle for short periods. The return to the breast may be made when such causes are removed.

When a child is not gaining in weight and strength at the breast, the most careful observations should be made. The only way to determine whether a sufficient quantity of milk is being supplied is by frequently weighing the infant before and after nursing, in this way we may determine the amount supplied at each feeding.

An absolutely correct estimate of the quality of mother's milk can be secured only through an ex-

tensive and complete analysis which requires the service of an expert chemist. The percentage of fat can be roughly estimated by means of the Holt instrument or the Milchprüfer (pioskop). In estimating breast milk it is well to bear in mind one fact, and that is that the milk during the first few moments of nursing is the poorest, the richest milk coming at the end of the nursing, half way of the feeding giving us the best average.

Wet nurses are not as much employed in America as in other countries. This fact is to be regretted since there are many infants who are either born weak or have become so through illness, especially of the gastrointestinal type, which can be saved in no other way than through wet nursing, when their mothers have not a sufficient supply. All the rules governing maternal feeding apply equally to the wet nursing, with the further provision that all wet nurses should be proven to be free from tuberculosis, syphilis and gonorrhea and with the still further provision that the wet nurse can also nurse her own baby to whom she owes her first duty.

Mixed feeding of breast and bottle must often of necessity be resorted to. The same general rules suggested above apply in this case as applies to the maternal nursing alone and to artificial feeding (subsequent chapter) with the following exceptions—that it is well to determine the capacity of the child's stomach and the interval of feeding necessary by giving several successive bottle feedings,

then to determine the amount of milk the mother supplies at each nursing by weighing the baby several times before and after feeding. Whether we use complementary or supplementary feedings will depend on the indications. In supplementary feeding we make up the deficiency at each maternal nursing by a bottle feeding; in complementary feeding, we alternate the two. The best rule to follow here is that if the quantity of the mother's milk is deficient, we put the baby to the breast at the regular hours and then supplement with the bottle; if the quality of the mother's milk is deficient, we use the complementary feedings, thus allowing the mother to rest for a longer period. In these cases we should always bear in mind two facts; the baby's mouth is the best stimulus to the mother's breast and that we should hold on to mother's milk if it is only one nursing a day as long as the child needs constant attention.

## CHAPTER VI.

## THE HANDLING OF A NORMAL BABY ON THE BOTTLE

WHEN we have a strictly normal baby to deal with, one that is well developed and nourished, whether this child is started on the bottle at birth or later, the problem before us is comparatively simple. This is the simplest of all infant feeding problems, although, in the strictest sense of the word, none is simple.

In a somewhat extended experience in the feeding of infants, I have yet to see one which could not take some modification of cow's milk. The term "adaptation" used by Kerley is decidedly the best term, since infant feeding consists essentially in adapting the proportions of the various elements in cow's milk to the digestive powers of the infant. We must bear in mind as a guide the percentages of the various elements as contained in mother's milk and cow's milk. An average of mother's milk contains 3.5 per cent fat, 7 per cent sugar, and 1.50 per cent proteid; while cow's milk contains 4 per cent fat, 4.5 per cent sugar and 3.2 per cent proteid. It will be seen at a glance that the percentage of fat in cow's milk is slightly above that of the human milk; sugar 2.5 per cent lower than the

sugar of human milk while the proteid of cow's milk is nearly 2.5 times as great as that of mother's milk.

As stated, the modifying of cow's milk so as to conform even exactly to human milk does not form a suitable adaptation to the infant's digestion and it is essential to modify it still further. It would be a hazardous procedure to place a young infant on a modification of cow's milk which contained 3.5 per cent of fat (the percentage contained in mother's milk), also even 1.5 per cent of proteid of cow's milk is entirely too strong to begin feeding an infant.

Another important fact to bear in mind is that mother's milk varies very slightly during the whole period of lactation and even the quantity of mother's milk varies within comparatively narrow limits, hence, on a more or less fixed proportion of quality and quantity an infant at the breast thrives over a period of from eight to twelve months.

A striking feature of artificial feeding is that infants require a gradually increasing amount of modified milk both as to the proportion of ingredients and as to total quantity. This fact alone proves to us the vastly different requirements of the infant when fed on the breast and on cow's milk and reminds us at once of the absolute necessity of gradually adapting the infant's digestion to the more difficult cow's milk. To any one doing a considerable amount of consultation work among infants one fact is apparent and that is that the

overtaxing of the infant's digestion by too large proportions of elements in cow's milk is much more frequent than the weakening of the digestion by a protracted feeding of too small proportions, although the latter class of cases does arise. Our main reliance must be comparatively weak mixtures to begin with, increasing them gradually until the digestion is equal to the task put upon it; in other words, the infant must be assisted in acquiring a tolerance for each element.

When we deal with percentages, we are, of course, using approximate quantities. The milk from one herd will differ from the milk of another herd in the percentages of fat and proteid, the sugar usually being constant. At the same time, unless we are dealing with a certified milk which is certified even to the extent of the percentage of the various elements, certainly at least that of the fat, we may assume that cow's milk contains the percentage stated above and this is near enough for working purposes.

The expressing of feeding in terms of percentages, therefore, calls for only approximation to accuracy, but is thoroughly useful to keep us generally informed as to the quantity of each ingredient prescribed for the infant. In this way as in no other we may reduce the fat and increase the proteid even as much as .25 per cent at will and with comparative ease. Infants vary considerably in their ability to digest the fat content of cow's milk. In healthy infants it is rarely necessary to start

with less than one per cent even during the first two weeks of life. Some authorities are accustomed to give the new-born infant as high as 2 per cent of fat. I have found this, generally, unwise and rarely risk more than 1 per cent. The fat is gradually increased as necessity and indication require and I think it a safe rule never to give beyond 4 per cent, and in my practice I rarely exceed 3 per cent even towards the end of the first year.

The variations and capability of digesting sugar are second only to those of fat, a safe rule being to range from 4 to 7 per cent. I rarely use less than 5 per cent even in young infants and practically never exceed 7 per cent. I am quite aware of the fact that some infants acquire an enormous tolerance for sugar. This is frequently demonstrated to me when I see infants fed for long periods of time on condensed milk mixtures unusually high in sugar and those fed on proprietary foods especially those rich in malt sugar. But, as I have pointed out before, when an intolerance for sugar is once established, it is one of the most difficult of the feeding problems to overcome, hence, it will be safer to use the range indicated above.

The proteid of cow's milk undoubtedly gives us the least amount of trouble, intolerance usually being confined to those cases presenting putrefactive manifestations. In instances of the large casein curds in the stools, the proteid content must be kept well within reasonable limits and in a nor-

mal infant I rarely exceed 2 per cent proteid and practically never go beyond 2.5 per cent.

When whole milk mixtures are substituted of course the percentage will more rapidly approximate that found in cow's milk, but in my own experience, few infants under 13 or 14 months are capable of handling whole cow's milk.

The first formula given any child with which we are not thoroughly familiar is inevitably an experiment, and yet if we secure a careful history of previous feedings, the gain in weight or otherwise and after an examination of the stools, we should be able to approximate quite nearly the requirements of the individual infant. This is especially true if we take the time to calculate the caloric needs of the infant and check this up after the formula has been worked out.

The following tables furnish us with a theoretical basis for our guidance in feeding normal healthy babies:

| Age | Percentage of Fat | Percentage of Sugar | Percentage of Proteid |
|---|---|---|---|
| Premature | .50 | 4.00 | .25 |
| | 1.00 | 4.00 | .25 |
| First week | 1.00 | 5.00 | .25 |
| | 1.50 | 5.00 | .50 |
| Second week | 1.50 | 5.00 | .50 |
| | 2.00 | 5.00 | .75 |
| Third week | 2.00 | 5.00 | .75 |
| | 2.00 | 6.00 | 1.00 |
| First to second month | 2.00 | 6.00 | 1.00 |
| | 3.00 | 6.00 | 1.00 |

| Age | Percentage of Fat | Percentage of Sugar | Percentage of Proteid |
|---|---|---|---|
| Third month | 3.00 | 6.00 | 1.25 |
| Fourth month | 3.00 | 6.00 | 1.50 |
| Fifth month | 3.25 | 7.00 | 1.75 |
| Sixth month | 3.50 | 7.00 | 1.75 |
| Seventh month | 3.50 | 7.00 | 1.75 |
| Eighth month | 3.50 | 7.00 | 2.00 |
| Ninth month | 4.00 | 7.00 | 2.00 |
| Tenth month | 4.00 | 6.00 | 2.00 |
| Eleventh month | 4.00 | 6.00 | 2.50 |
| Twelfth month | 4.00 | 5.00 | 3.00 |
| Thirteenth month | 4.00 | 4.50 | 3.20 |

It must be borne in mind that this is merely a suggestive table for average babies and that weight and general nutrition must guide us rather than age, since a delicate infant at six months may only be able to take a formula which is intended for a three or four months old baby; on the contrary, a lusty baby at four months may require a formula which is intended for a six months' infant. Under such circumstances a check by means of calories is advisable.

It is with great hesitancy that I give a schedule of quantities for feeding at all, since I have emphasized the fact that the individual child is a law unto himself in this particular more than any other and that variations are very great between infants of the same age and weight and yet it is useful to have some safe guide to follow when beginning

a child on the bottle. With this clearly understood, I venture to give the following table:

| Age | Oz. per Feeding |
|---|---|
| Premature | ½ to 1 |
| First week | 1 " 2 |
| Second week | 1½ " 2½ |
| Third week | 2 " 3 |
| First to second month | 2½ " 4½ |
| Third month | 3 " 5 |
| Fourth month | 3 " 5½ |
| Fifth month | 3½ " 6 |
| Sixth month | 4½ " 6½ |
| Seventh month | 5 " 7 |
| Eighth month | 5½ " 7 |
| Ninth month | 6 " 7½ |
| Tenth month | 6½ " 8 |
| Eleventh month | 6½ " 9 |
| Twelfth month | 7 " 9 |
| Thirteenth month | 7 " 10 |

We have already considered the question of interval of feeding, but this is an important subject and can bear the second reference. It is rarely necessary to begin any infant on two hour intervals of feeding; two and a half hours, even among very young infants unless they are exceedingly delicate, is frequent enough. Perhaps the most convenient feeding interval is three hours; this is especially true in institutions where large numbers of babies are handled and consideration must be had for the time of the attendants. However, in private practice we may vary from two and a half hours to four according to the child's appetite and general digestive capacity. This, as well as the quantity of each feeding, must be determined largely by the

individual infant and I do not believe that we can lay down any rule on this subject.

A weekly record of the child's weight should be kept and a safe average maintained. The attending physician should always inspect the stools himself and not trust to the statement made by the mother. An examination based on the observations made in the chapter on infant stools is absolutely necessary in the feeding of all infants.

All artificially fed infants should be under the constant observation of a physician. Weekly or biweekly reports should be made in the case of those doing well and of course oftener when necessary. A mother or nurse should never increase the strength of a formula without the advice of the physician. Those in charge of infants should have explained to them certain symptoms which require immediate reduction in certain food elements so that if the physician is not available this may be done, but as a rule there is ample time.

In increasing the elements week by week or whenever necessary, it is well to increase the proteid one period and the fat the next, inspecting the stools from time to time to satisfy ourselves that the element is being well digested. It is just as important to bear in mind the rule which I follow for sick infants in feeding the healthy—first, symptom free; second, hungry; third, increase in weight. Our first aim should be to keep or make the baby free from such symptoms as regurgitation, vomiting, diarrhea, constipation and colic.

When this has been accomplished keep the child on that particular formula until it is hungry and then and then only may we safely look to an increase in weight.

One symptom is frequently very troublesome and hard to control—constipation. It is undoubtedly due to a disproportion in the food elements, and, as a rule, is readily corrected by a readjustment of these elements. The fat is more frequently the cause and at times it is necessary to reduce the fat to a very small percentage or even to eliminate it entirely for a while and gradually increase until the digestion is improved, on account of a gradually acquired tolerance. It is necessary in these cases to check the food elements by calculating the calories so that the infant may secure a sufficient ration. One very frequent cause of habitual constipation is the constant use of enemas and suppositories or soap sticks. By the use of these, artificial stimulation becomes the rule, the bowel relying on this before acting. When the food disturbance cannot be readily adjusted, milk of magnesia should be our main reliance. This is best administered by giving the dose required for a single purgation in the total twenty-four hour mixture. It will thus be equally divided into small doses in each bottle. Quite recently I have had very good success with white mineral oil (liquid paraffin). Regularity of habits of feeding and bowels is essential to success and no detail or symptom should be considered too small for the consideration of the physician.

## CHAPTER VII.

## THE CARE OF THE PREMATURE INFANT

THE care of the premature infant, so far as the life of the infant is concerned, is one of the most hazardous risks in the whole of medicine. Under ordinary circumstances the mortality is exceedingly high and the success or failure in the rearing of such infants is in proportion to the amount of prematurity. In other words, a child from two weeks to a month premature and which is quite well developed for this age, stands a very reasonable chance of being reared and the further we get away from full term development, the less chance we have of success.

The three main indications in handling the premature infant are "the maintaining of normal heat; the nourishing of the infant; the prevention of infection." All newly-born infants have the heat regulating center poorly developed, hence, even with normal infants it is unwise to expose them to sudden changes of temperature. If this is important in the case of the full term child, it is many times more important for the premature, therefore, we should not bathe the premature infant at all at first. It should be oiled (olive oil) and this oil reapplied not oftener than every other day until the infant becomes as lusty as a full term child.

The ordinary clothing of an infant should not be used at all; in this stage we may wrap the child in absorbent wool which has been quilted, or in the so-called premature infant's gown. Whatever wrapping is employed should include the head, only the face being left open, and instead of the usual napkin, we put a pad of absorbent cotton to receive the discharges and this alone should be changed with regularity. The question of incubators is one that is much mooted and outside of well regulated institutions with nurses trained especially in the care of this class of infants they are not successful. As most of our work deals with the infant in the home, we use a basket or bassinet which has been well padded at the bottom and on the sides. The infant is placed in this and not removed at all even for its feedings. The heat may be maintained by the use of hot water bottles or bags not put close enough to the infant to burn it, or by the use of the electric pad attached to the ordinary electric light socket which may be placed underneath the infant sufficiently covered by blankets or cotton to protect it. I am told that this occasionally gets out of order and consequently must be carefully watched and kept from burning the infant. The infant's temperature must be maintained at from 98 to 99 degrees as nearly as possible. To do this we resort to the use of two thermometers, the ordinary household thermometer which is placed lying on the child's clothing and below the bed covering and should register some-

Fig. 2.—Premature infant in quilted gown.

where between 85 and 95, depending on the temperature of the child's body which must be measured by means of a rectal thermometer several times a day for the early period of these premature existences. A temperature of 100 means that the child is getting too much external heat; a temperature of 97 that it is getting too little heat. As a rule, these infants can be reared, so far as the heat is concerned, as successfully in this way as they can in an incubator.

The atmosphere which they breathe should not be as hot as that usually considered necessary, 72 degrees should be the hottest and the air of the room should be changed frequently to insure freshness.

The second indication, that of nourishment, is best met through breast milk. The milk of the child's mother is rarely available during the time of prematurity because it is not produced at this early stage, consequently, especially in the very young premature infant, the milk of a wet nurse is absolutely essential. It is rare, however, that we find a premature infant that can nurse from the breast or bottle so the wet nurse must have her breast pumped at regular intervals to secure this milk. She should be nursed at the same time by her own infant to secure a steady flow of the secretion, otherwise the milk will dry up quite rapidly. It is rare that we find a premature infant that can take even mother's milk whole, consequently they must be fed a dilution of the breast

milk of about equal parts with a five per cent sugar solution. It may be necessary to give this by means of a medicine dropper or Breck feeder, or in the very weak, by means of the stomach tube which is passed through the nose or mouth of the infant into the stomach while it is lying in the crib. Whichever method is necessary, the child should never be removed from its basket for any purpose whatever except for the periodical oiling. This oiling should be done as quickly as possible and in a room whose temperature is approximately 90 degrees F.

The amount which the baby can take at each feeding depends entirely on the baby, from one-half to one ounce is the rule and from one and a half to two hours should be the interval.

When breast milk is no longer necessary we resort to the usual modifications of cow's milk commencing with fat .50 to 1, sugar 4.50 to 5, proteid .75 to 1, and gradually working up in strength as the child's ability to assimilate is developed.

The third indication—prevention of infection—is an exceedingly important one. Three avenues of infection are most usual in these cases; the mouth, the lungs and the umbilicus. The mouth should be kept as clean as possible without irritating the mucous membrane. To accomplish this, the utmost gentleness in handling is absolutely necessary; nor is too frequent bathing of the mouth advisable, for through this means we may cause vomiting through irritation of the throat. Pneumonia

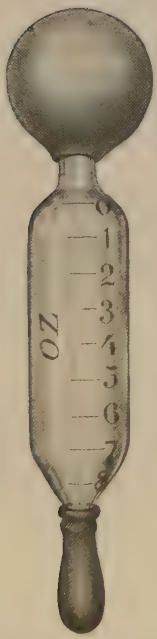



Fig. 3.—The Breck Feeder.

is exceedingly common in these cases, to prevent which, a free flow of fresh air in the room constantly is absolutely necessary even while maintaining the bodily heat in the basket. The umbilicus needs only the care which is given any new-born baby, but if infection gains entrance, we have practically a hopeless task before us in attempting to save the child.

The question of weight in these infants is even more important than under other conditions. The weighing may be done very quickly at the time of the oiling in a warm room and may be done with the child dressed in its premature gown making a deduction for the weight of the gown, although this method is exceedingly inaccurate.

## CHAPTER VIII.

## DIGESTIVE DISTURBANCES OF THE BREAST FED INFANT

BOTH nutritional and digestive disturbances are comparatively infrequent in breast fed children, or at least, are so slight or so transient that the physician is rarely called to attend them since they usually escape notice or are deemed of insufficient importance to require his services, and just here lies the real danger because not infrequently such damage is done that when the physician is called he has difficulty in correcting it.

Loss of weight or stationary weight in the nursing child, in my opinion, is the result of insufficient quantity of mother's milk and but rarely the result of impaired quality of the milk. Unless the infant is weighed at stated intervals, the stationary or falling weight may not be noticed for some time, with the result that the infant not only loses weight which is difficult for him to make up, but also the digestive power is lowered because he has not had enough food to stimulate it. Under these circumstances when the change to artificial feeding is made there is difficulty in adjusting the food to the digestion. It is far better, therefore, when it is certain that the mother is not giving a sufficient quantity to make use of the bottle before

the child has begun to be marantic. When the bottle appears to be unavoidable, we should endeavor to find out how much milk the mother is giving by weighing the baby before and after each nursing; this should be done several times a day for several days and then, in the majority of cases, a bottle containing a sufficient amount to make up the deficiency in the quantity of the breast milk should be given to supplement each breast feeding. In this way the mother's breast has the advantage of the constant stimulation from the baby's mouth and consequently the possibility is maintained of increasing her supply, but when this fails and the mother's milk shows a steady decrease, resort must be made to complementary feedings. At first we may substitute perhaps two bottles of full feeding for two maternal nursings and the effort must be made constantly to keep up the breast as long as possible, even if only a partial breast feeding can be given two or three times a day, because the infant certainly takes cow's milk far better in the presence of small quantities of breast milk than with none at all.

In weighing the baby to determine either the amount of mother's milk furnished or to find the net weight, the baby should always be weighed nude.

The infant's stools furnish us a very valuable guide in determining the nature of the nourishment. They frequently acquire the "starvation stool" character, which is brownish or greenish and very small and thin, frequently so small as to make

merely a stain on the napkin. This stool resembles very closely the "starvation stool" of the artificially fed.

Inanition fever has been described by Holt as coming on about the end of the first week of life. After excluding such causes of fever as infectious and the toxemia of the new born and assuring ourselves that the mother is giving an insufficient supply of milk, feeding the infant a solution of milk sugar or a weak solution of cow's milk mixture should cause this fever to disappear. I have seldom seen this condition myself and its frequency I cannot vouch for.

The toxemia of the new born has been described by Morse. This usually develops before the termination of the meconium stools and is a true infection, presumably arising from careless or unclean handling of the mouth through which channel it is supposed to enter.

Its treatment consists in withdrawing all milk products, giving a purgative, preferably of milk of magnesia and substituting a five per cent solution of milk sugar until the fever has subsided when a return to the original feeding can be made almost immediately.

**Colic** in the breast fed is more common than is usually supposed. This symptom undoubtedly arises from some form of dyspepsia and when met with is very frequently a troublesome condition. The most frequent manifestation is pain with intermittent or constant crying sometimes bearing

a definite relation to the feeding and at other times no relation whatever to it. It is frequently relieved by nursing only to come on with renewed vigor a short while afterwards. In the majority of instances it is accompanied by the formation and expulsion of gas both from the stomach and bowel. If from the bowel, a simple suds enema will usually relieve the individual attack, but carminatives such as asafetida, peppermint and soda, and fennel and catnip may be wisely resorted to. In handling these cases thus it is obvious that we are merely treating symptoms and not the real underlying cause. Colic most frequently occurs in well nourished infants.

**Vomiting** may occur as an accompaniment to or quite independent of colic. In the vast majority of instances whether in the breast fed or bottle fed vomiting has its origin in one of four causes: too much feeding, too frequent feeding, too high percentage of fat, too much handling. I believe that the frequent and unnecessary habit of jolting infants is responsible for the largest percentage of vomiting. Cases in which handling is responsible should be easily corrected by a little patience and persistence on the part of those having the care of the infant. Where too large quantities or too frequent feedings are the cause, the cutting down of the time of nursing or the lengthening of the intervals or both should correct this. Even in healthy nursing mothers I find indigestion of this type can be relieved by commencing with very

short feeding, using a clock as a guide and not guess work. I not infrequently reduce the length of feeding to one minute gradually increasing to two, three, four, five, up to a normal fifteen or twenty minute feeding, and in these cases the longer interval between feedings is sometimes exceedingly helpful. Where the mother's milk is too rich in fat or proteid we sometimes have great difficulty. I do not approve of dieting a nursing mother too much, though very rich or highly seasoned foods must be interdicted. When the fat is at fault as indicated by the vomiting of very sour food soon after nursing and almost always by the presence of the small white fat curds in the stools, it usually becomes necessary to dilute the mother's milk. This may be done by feeding a little boiled water just before or after nursing. I think the first better as the baby is more apt to take it when hungry than after a partial feeding. Moderate outdoor exercise on the part of the mother will relieve this condition more promptly than anything else. This is especially true where the proteids in the mother's milk are at fault. In these instances the stools may or may not contain casein curds (the large hard brown curds resembling almonds). The nursing of an infant at regular intervals cannot be too strongly emphasized. The habit of nursing a child whenever it cries is pernicious in the extreme because as a rule these children are crying not from hunger but from indigestion caused by too frequent feedings. A steady gain in weight

with freedom from symptoms as colic and the like in the breast fed infant should satisfy us of its proper nutrition. In addition to these disturbances, breast fed babies are subject to the acute gastric and intestinal indigestions described in the next chapter but very rarely with the same degree of severity. Their handling is essentially the same as that given under "artificial feeding" except that we are rarely compelled to withhold food for so long a time and of course we dilute the food in the breast fed infant by giving some boiled water before each nursing, otherwise, their handling is practically the same.

## CHAPTER IX.

## DIGESTIVE DISTURBANCES IN ARTIFICIALLY FED INFANTS

THE limitations of a book of this nature are such as to admit of the merest suggestions of these conditions. As has already been stated, the proteid in cow's milk was, for a long time, blamed for most if not all of the digestive disturbances in the artificially fed infant. After a while opinion changed and fat bore the weight of the burden, then sugar came in for its share of the blame as the cause of the trouble and lastly the salts have been considered. Investigation which placed the blame on a single element served a very definite purpose—that of proving that any element may cause digestive disturbances and that a disturbance which is caused primarily by an excess of any one element beyond the capabilities of that individual infant, also ultimately results in an inability to digest properly all other elements. Therefore, it is clear that all of our resources must be watched, as probable trouble causers, and their proportion particularly regarded in the readjustment of food to the capabilities of a deranged digestion. When it is shown that an infant is receiving a sufficient supply of food and yet is not

gaining, or is becoming atrophic, a careful history of the food of such an infant will most likely display at some time an overtaxed digestion from an excess of one or all food elements and rarely from a deficiency of these. Whenever a disproportion occurs between the digestive powers and the work put upon them, trouble is sure to ensue. This trouble may be acute, ending occasionally in death, generally in a recovery, but not infrequently develops gradually into a chronic indigestion. Digestive disturbances, therefore, may well be divided into acute and chronic.

### Acute Indigestion.

**Gastric Indigestion of Nervous Origin.**—This is a disturbance of the digestive power of the stomach through nervous influences such as sudden or prolonged overheating (heat stroke), fatigue, undue excitement, such as playing with a child too much, etc., fright and other emotions (usually in older children). This type is characterized by vomiting, usually precipitate and without much nausea, vomiting being rarely prolonged. It usually clears up after the stomach is entirely emptied; fever is either absent or moderate, rarely high, for a few hours.

*Indications for Treatment.*—If the stomach is not completely emptied as indicated by continued vomiting, a stomach washing may be necessary, although cases requiring this are exceedingly rare. Give the stomach a rest for a while, usually for

ten or twelve hours, and administer a suds enema; a purgative is sometimes advisable. Calomel is best under these circumstances since other purgatives are apt to be promptly vomited; it is best to give the calomel in small repeated doses—for example, one-tenth of a grain every half hour for five or six doses is usually sufficient. The day following, the food should be cut down to one-half the strength and by the second day it is usually safe to return to the full diet.

**True Acute Gastric Indigestion.**—This is usually due to a "food outrage," that is, too much or too concentrated food or to a great preponderance of one of the food elements. Fat and sugar are the elements which most frequently cause trouble. This type is characterized by the vomiting of food, frequently clabbered to such an extent that it forms a complete cast of the stomach. The vomiting is more or less persistent and may continue for several days in an acute form so that everything taken, even water, is vomited. If this class of cases is not promptly and properly handled, then the chances are very great that they will pass into the chronic form. The fever is very slight or suddenly and briefly high unless true gastritis intervenes in which event a continuance of the high fever is the rule.

*Indications for Treatment.*—The first indication is to empty the stomach. The vomiting usually ceases of its own accord just as soon as the stomach is emptied completely, but if the vomiting is

persistent, stomach washing should be done without delay; usually one washing will suffice, but if not, it should be repeated. An enema should always be given to empty the lower bowel to prevent a continuance of vomiting from toxic absorption. Calomel may be exhibited as in the nervous type but if this induces vomiting it should be stopped at once. The second important indication is a complete and continued withdrawal of food and a *very* gradual return to normal diet. The stomach should be given a *complete rest* for at least twenty-four hours; by this I mean that nothing whatever, not even water should be given by mouth; a rigid adherence to this cannot be too strongly emphasized. We should then give very small quantities of boiled water, gradually increasing the quantity until we are sure that the stomach is not going to rebel. When we have reached this stage, we may begin to give very small quantities of *very diluted food.* To begin with, the least possible percentages should be used. For infants under six months old either whey made from skim milk, which gives a formula of 0 fat, 4.5 sugar, .90 whey proteid; or even in some instances diluted whey. In cases occurring after six months, cereal water may be given instead of whey, although whey is exceedingly useful at all ages. When the infant is taking the whole whey or cereal water with impunity we may begin to add milk ingredients. Since the fat is more frequently the cause of trouble it is best to start with small

amounts of skim milk so as to make the proteid as low as .50 per cent, then .75 per cent, then 1 per cent. When the skim milk is added to whey, we have a split proteid, in this case the per cent of proteid referred to being the casein; the whey proteid remaining constant. By the time the child has gotten up to 1 per cent of proteid we may begin to add fat, first, as small an amount as .50 per cent or in some instances .25 per cent and gradually increase. After attacks of this kind the infant may take the fat badly for a long time and I have found that under these circumstances the fat is better borne in the presence of malt sugar than any other form. The vomiting in acute gastric indigestion must always be distinguished from the nervous type, "recurrent vomiting," commencing infectious diseases (rare under one year), toxemia, etc.

### Acute Intestinal Indigestion.

**Nervous.**—There is a nervous diarrhea in every respect analogous to the nervous vomiting. It may or may not be accompanied by vomiting; the causes are the same and need not be repeated. Its characteristics are a mild diarrhea without straining; as a rule stools well digested and devoid of mucus or blood; fever is moderate and of short duration if present at all; prostration slight.

*Indications for Treatment.*—Essentially the same as in nervous vomiting just described, if vomiting accompanies it; if there is no vomiting, an initial dose of castor oil or milk of magnesia, the former

preferably, and cutting down the food strength one-half or more until acute symptoms have subsided; after this, a gradual return to normal food may be allowed.

**True Acute Intestinal Indigestion.**—This condition is usually due to a sudden disturbance of the proportion between the digestive power and the food. Its characteristics are slight fever which is not persistent; the stools are loose, lumpy, not well digested, rarely green or foul; blood and mucus invariably absent unless the diarrheal condition is prolonged; straining is absent or slight; vomiting may occasionally be present.

*Indications for Treatment.*—The same as in gastric indigestion if accompanied by vomiting, if not, an initial dose of castor oil should always be given and food should be cut down to one-half or less for a day or two or until acute symptoms have subsided, then a gradual return to normal, bearing in mind as stated above that the fat is less well borne than the proteid. In intestinal indigestion as in gastric, malt sugar is especially serviceable after the diarrheal symptoms have subsided by aiding in the digestion of fat and also in promoting a gain in weight. In all of the cases just mentioned an initial loss of weight is the rule and to be expected, but the keynote in handling them is that the weight is secondary in importance to the relief of symptoms. After we are quite sure that the child is assimilating its food properly, we may then begin to look after the weight. An infectious diar-

rhea may be regularly implanted on an acute intestinal indigestion, which, however, will be considered in a separate chapter. It is well to bear in mind that intussusception is often mistaken for this condition when there is vomiting and blood in the stools.

### Chronic Gastric Indigestion.

This condition may immediately supervene on an attack of acute gastric indigestion or it may develop so gradually that it is hardly noticed by the parents, in which event it is due almost always to the continued use of the wrong kind of food or to bad habits. I find this condition most frequently where too strong dilutions of cow's milk have been used or the continued use of proprietary foods rich in sugar; however, any irregularity in feeding may be responsible. This condition is usually present in chronic constitutional diseases. It is characterized largely by vomiting of either large or small amounts of the stomach contents accompanying or immediately following feeding, or very frequently small amounts are vomited at irregular intervals. One of the most constant manifestations is the vomiting of "sour water" as so frequently described by the mother. The child's appetite may be very meager or it may take with avidity any food which is given it only to vomit it very promptly. This is due to the child's mistaking the discomfort of the indigestion for hunger, there is either stationary weight or loss of weight.

The abdomen is almost always hard and distended. This condition may be an accompaniment of chronic intestinal indigestion or the intestinal symptoms may predominate which gives us the true type of chronic intestinal indigestion.

### Chronic Intestinal Indigestion.

The causes of this condition are essentially those mentioned in the preceding paragraph. This condition is one that is comparatively common in breast fed infants though of course more frequently seen in those artificially fed. I believe that the vast majority of these cases are produced by the prolonged use of proprietary foods, particularly those which are rich in starches. The characteristics are either continuous diarrhea or an obstinate constipation or an alternation of these conditions usually accompanied by mucus in the stools, sometimes blood and almost invariably a great deal of flatus. Stools are frequently so irritating that they cause excoriation of the skin, this is particularly true where there is fermentation due to starch and sugar ingredients. The stools may or may not contain mucus and are seldom exceedingly foul though the green color usually predominates. In the constipated cases the stools may be hard and firm, clay colored, and frequently have scybalous masses. It is needless to say that there is almost always a steady loss of weight and it is these cases which result in the development of the typical marasmus infant.

*Indications for Treatment.*—These chronic indigestion cases, both gastric and intestinal, are so clearly dietary that they will be discussed in the chapter on difficult feeding cases.

## CHAPTER X.

## HANDLING OF DIFFICULT FEEDING CASES.

I HAVE stated that the feeding of a healthy baby on the bottle was a problem of comparative simplicity. The feeding of an infant with a deranged digestion is the most difficult problem that I have ever been called upon to undertake in the field of medicine. Nothing taxes the judgment or the knowledge of the underlying principles of digestion so much as this and upon the knowledge and judgment born of long experience depends whatever success we may attain.

There are two great classes of infants which present difficult problems in feeding—first, those who from prematurity or congenital weakness are capable of digesting only the weakest dilutions of the ingredients of cow's milk; who have to be watched constantly and carefully for the slightest derangement of digestion; the second, and by far the larger group, are those whose digestion has become deranged as a result of improper methods of feeding. Both of these classes require particular attention to be paid to the following points: the capacity of the stomach, by a fair estimate of which alone are we enabled to determine the

amount to be given at each feeding, and the period of time required for the individual stomach to empty itself; a frequent estimate of the gain in weight and a most careful watching of the stools. These cases present problems which are difficult for the most astute observer to solve and in many instances it is unfortunately true that the problem is never solved.

The error which I see most frequently made is in not giving the digestion a fair trial on any one formula, and one constantly sees changes made as often as every day; in such rapid succession, in fact, that the child is in reality upset because of this very rapid change. As a general rule, three days is the shortest time in which we may observe the effects of a change on the digestion. These cases cannot be handled by a rule of thumb, but one rule must be observed, namely, such a formula must be used as will give us a patient who is practically symptom free, who has no vomiting, no colic, stools approximately normal. When this degree of dilution has been reached, it must be maintained until the child is hungry, proving that a truly hungry child means one whose digestive power has reached the stage at which it demands more food. After we have secured these two conditions, we may then safely endeavor to increase the infant's weight. To accomplish this, it has certainly been borne out in my personal experience that modifications of cow's milk are still to be our main reliance, but one important point must be borne in

mind; the proportions of the three main elements, and especially the fat and the proteid, must be reduced to begin with to the smallest possible quantity at which life can be maintained. I have never seen any advantage to be derived from condensed milk. If one will only stop and consider carefully the formulæ of the various condensed milk dilutions, he will see that the same proportions can be obtained from modified cow's milk, and in my experience, much more advantageously to the requirements of the infant digestion. I have found in these cases whey to be of inestimable value. This may be made, according to indications, from whole milk or fat free milk, that is, skim milk. In the first instance we have a formula approximating .90 fat—4.50 sugar—.90 whey proteid, while whey from skim milk contains the same formula with a theoretical zero percentage of fat, while, practically, I think we still have about .05 per cent. It is occasionally necessary to start these cases for twenty-four or forty-eight hours on even diluted whey mixtures before they can be freed from various symptoms, but naturally these preparations cannot maintain life very long and it is essential to add the other ingredients gradually, commencing with the addition of small quantities of skim milk always in such proportions as to give us a more or less definite idea of the percentage of proteid given and even to begin on the lower percentages of fat by the addition of the necessary quantity of cream.

According to Holt the three main groups of these cases are as follows: first, those whose chief symptom is habitual vomiting or regurgitation of food; second, those with intestinal symptoms, most frequently with loose stools; third, those with no marked symptoms of indigestion yet whose weight is much below the average, who do not gain on weak food and yet are upset by stronger food, who have feeble digestion rather than indigestion. To these cases I would add a fourth group, those who take apparently normal preparations of food and who are habitually constipated and do not gain.

The cases in which vomiting is the main symptom are, as a rule, the easiest to handle. If we bear in mind what has already been said about the causes of vomiting we will find that these cases are just as abundant in the class of cases under observation as they are in the acute forms and the too frequent feeding of too large amounts at each feeding or too much handling play important parts, but from the standpoint of the food element, fat again comes to the front as a trouble maker. However, sugars may also cause this, particularly the malt sugars, and this is perhaps the reason why we see so many of these cases following the use of many of the proprietary preparations. These cases for a while regurgitate, as a rule, only small quantities of undigested food or sour milk, sometimes merely a watery fluid which is the second step in the process of indigestion, finally, mucus forms a large part of the vomited matter.

In the intestinal group we may have diarrhea in which there is either a large number of partially digested stools or a typical fluid stool in which mucus sooner or later appears in large quantities. Colic is not the rule, but it may occasionally occur as may also constipation. As in the former class of cases, the fat is most to be blamed, but frequently we find again the combination of fat and sugar intolerance. In the third named group above it is exceedingly difficult to determine what is the cause. As a rule, we will find some constitutional disturbance in which general measures such as fresh air, change of climate, etc., play the most important part in the treatment. In the fourth group which has been added by the author, the cause is also difficult to determine. In this group, I think it is wise in addition to the general measures such as have just been mentioned, to begin all over again, as it were, on diluted preparations of all ingredients and work up *de novo* as if we were dealing with a freshly weaned child. The only drug in any of these cases which I think does any particular amount of good is nux vomica in small doses, which seems to have a stimulating influence on all the digestive functions. The management of all these cases requires the most careful watchfulness. As a rule we can succeed only after a careful examination of the stools both macroscopically and microscopically to determine what food element is passing through the digestive tract without having been acted upon. When we can discover this, we have

usually accomplished a great deal in the treatment, while a computation of the balance between the caloric needs of the child and the amount being taken is indispensable. I have repeatedly stated that fat, at least in my experience, is best handled in the presence of malt sugar but right here lies a danger point. It is comparatively easy to correct the trouble if we discover that there is an intolerance for one food element, but where fat and sugar have both been given in excessive quantities and fat and sugar intolerance have both been established, we have one of the most difficult problems to handle of which I know. In these cases, I think the Eiweiss-Milch of Finkelstein is a great help, but it is undoubtedly of more benefit in difficult cases of the second year than of those of the first year. As a rule, in all these cases a formula which is exceedingly low in fat, a sugar content of from 3 to 4 per cent and proteid not exceeding 1.5 per cent helps us a great deal and here again I find the whey mixtures of great value. Occasionally we find buttermilk to be of advantage and not infrequently the stopping of all milk products for a limited period of time, not exceeding five to seven days, is absolutely necessary. In these cases, a wet nurse is only too frequently more harmful than she is beneficial. Our old rule will help us here as well as in the acute cases, that is, starting with a formula which is exceedingly low in all food elements and keeping on this formula until the infant is symptom-free and then gradually in-

creasing during the period in which we endeavor to stimulate the appetite, we can then safely go to the development of flesh. Long intervals of nursing with small quantities are invaluable in these cases. In this way better than any other we can induce the feeble digestion to care for the food administered and at the same time produce a desire for an increase. Many of these children may run low temperatures, but only too frequently the temperature may be sub-normal showing a very poor recuperative power.

In all these discussions, I have dwelt on general principles leaving to the study and ingenuity of the physician the actual formulæ which should be used, for I do not believe any rules can be laid down by which a child may be fed, or stated formulæ given for different children and conditions. A suggestive outline may be helpful, however. If we have started with whey we have a formula which is either—

| F | S | WP |
|---|---|---|
| .90 | 4.50 | .90 |

if whole milk has been used, or—

| F | S | WP |
|---|---|---|
| .0 | 4.50 | .90 |

if skim milk has been used. The latter is preferable when we have a fat intolerance. Then the increase may be made as follows—

| | | |
|---|---|---|
| .0 | 4.50 | 90/10 (split proteid) |
| .0 | 4.50 | 75/25 |

and if by this time we think fat can be well borne we may make the whey formula partially skim milk, giving approximately—

| | | |
|---|---|---|
| .50 | 4.50 | 75/25 |
| .90 | 4.50 | 75/25 |

then from whole milk. When this has been borne for a day or two we may be able to discard the whey and give such a formula as—

| | | |
|---|---|---|
| .75 | 4.50 | 1.00 |

If the case has been one of fat intolerance it is best to increase the proteid first and then the fat.

Thus—

| | | |
|---|---|---|
| .75 | 4.50 | 1.25 |
| 1.00 | 5.00 | 1.25 |
| 1.25 | 5.00 | 1.25 |
| 1.25 | 5.50 | 1.50 |
| 1.50 | 5.50 | 1.50 |
| 2.00 | 6.00 | 1.50 |

—and so on.

## CHAPTER XI.

## INFANT FEEDING DURING THE SECOND YEAR.

IN my experience, the feeding of healthy infants during the second year is a more difficult problem than during the first year and difficult cases occurring during this period present the hardest problem of all feeding. Authorities differ widely as to the proper time at which a baby should be weaned from the bottle. I think a safe average is at the twelfth month; lusty babies may be given small articles such as dry bread to chew before this period; the physical condition of others may demand that the bottle be kept up for some time longer. Certainly by the fifteenth month all milk which a baby consumes should be taken from a cup rather than a bottle. It is seldom that infants, for the first few months after the bottle stage is ended, can take whole cow's milk. It is, therefore, advisable to dilute the milk with some cereal gruel.

Below will be given a suggestive schedule for feeding at the various months during the second year.

**Second Year.**—Regularity of feeding is as essential as during the first year. The child should not be allowed to eat anything between the regu-

lar hours, nor should it be tempted with this or that thereby becoming a "taster." As soon as possible the cup should be substituted for the bottle. If this is not done, the child is apt to cling to the bottle as late as four or five years of age. Small amounts of cereals, toast, dry bread and zweibach should be tried at first and then we may branch off to other things. An artificial food which is common in the South and not elsewhere is batter-bread or "spoon-bread" which consists mainly of corn meal and eggs and is very wholesome. I find this as good as cereal and at the same time gives the eggs in a very digestible form. A general suggestive schedule follows:

For the first few months after weaning from the bottle we may use one of the two following schedules according to how the child has been fed during the previous months.

I.

6 to 6:30 a. m. Milk diluted ¼ with cereal gruel.

8:30 to 9 a. m. Orange juice.

10 a. m. Milk and gruel.

12 a. m. Bread (dry), toast and broth.

6 and 10 p. m. Diluted milk.

If a child is further advanced in feeding than usual we may use the following:

II.

7 a. m. Cereal, oatmeal, barley, wheat or hominy grits and diluted milk from cup. All cereals cooked for at least three hours in double boiler.

9 a. m. Orange juice.

11 a. m. Dry bread, broth, soft boiled egg (at first

the egg should be given every third day, then oftener), milk (use less and less dilution until by the fifteenth or sixteenth month we are using whole milk).

2 p. m. Baked potato, mashed with butter or drippings from steak or roast. (Must be kept fat free.) Beef juice is preferable.

5 and 9 p. m. Milk.

III.

(15th to 20th month)

7 to 8 a. m. Breakfast: Cereal, bread and milk, or batter-bread.

12 a. m. to 1 p. m. Dinner: Egg, potato, green vegetables, such as spinach and carrots (these may color the stools and pass through apparently undigested at first but this, as a rule, does not matter), beef juice, broth, rice and a dessert of rice or tapioca pudding, with little or no sugar.

5 to 6 p. m. Supper: Bread (toasted bread, or dry bread), cup of milk.

10 p. m. Milk (undiluted).

IV.

By the 20th month we may safely give the following, three meals a day usually being sufficient:

7 to 8 a. m. Breakfast: Cereal, batter-bread, toast or dry bread, egg, soft boiled or coddled, a little stewed fruit or scraped apple. Where fruit is not used at this time, orange juice may be given as above.

11 a. m. to 1 p. m. Dinner: Scraped beef, minced chicken, oysters (hearts cut out), finely cut up lamb, broths, potatoes (postpone the sweet potatoes until later as they cause fermentation), spinach, asparagus tips, carrots, rice; desserts of blanc mange, custards, rice and tapioca puddings, etc.

5 to 6 p. m. Supper: Bread, toasted hard or dry bread, cup of milk, stewed and sometimes raw fruits.

Use very little sugar in cooking fruits or puddings; never use as a simple sweetening. Candy should never be given until five or six years of age.

**Difficult Cases During the Second Year.**—A number of children pass through the first year in a state of unstable equilibrium from slight errors causing derangements of digestion. It is needless to say that these children enter the second year handicapped and form the first group of difficult feeding cases during the second year. In this group of cases it may be necessary to prolong the bottle feedings and even when solid food becomes a set portion of their diet, a modification of cow's milk may have to be carried on with the same care as during the first year. However, the danger must always be borne in mind of keeping the child on liquid diet too long because the digestion in this way is not stimulated to the activity which is necessary to the early years of childhood.

There is another class of cases which will go along on rational food for the second year for longer or shorter periods and suddenly have a complete breakdown, especially from the intestines. These are cases which are poorly understood. Where they are watched carefully, of course, the majority of them display an indiscretion on the part of the parent or physician in attempting to push the solid ingredients of food too rapidly. As a rule, this class of children take care of beef juice and broths better than the dilute vegetable products and yet the vegetable juices are so essential to child growth that they must be used if possible.

In deranged digestion during the second year, fruits are rarely well borne while sugars are posi-

tively contraindicated. In many instances I find that where sweetening is necessary in order to make the child take the food it should, a solution of saccharine is preferable to the standard sugars. In this class of cases more than any other is a careful examination of the stools necessary and, as a rule, it is wise to allow the child to have a more or less liberal diet during which time a careful study of the stools is made, both macroscopically and microscopically, to indicate all foods which show a passage through the digestive tract undigested. They can then be eliminated and a return to them should be exceedingly gradual in order to develop a tolerance. This class of cases requires infinite patience and perseverance on the part of the physician and absolute acquiescence on the part of the parent.

Most frequently fats are at fault, but by no means infrequently the sugars. In these the Eiweiss-Milch of Finkelstein is exceedingly valuable. When the fat is at fault children become and remain symptom-free more readily on this mixture than any other of which I know, but the weight is inclined to remain stationary. When they have reached a point, after weeks or months of this diet, when it appears safe, we may add an increasing percentage of malt sugar, which usually starts the weight upward very rapidly. If we are sure that there is no sugar intolerance we may begin with a liberal percentage of malt sugar in the Eiweiss-Milch.

These cases require months of most careful watching and the physician should impress this fact upon the parent very early. In many instances we are compelled to return to first year modifications of milk for sick infants for a while, in which case, the principle should be low fat, high proteid, moderate carbohydrate at first, but as soon as appears safe the carbohydrate may be increased gradually to reach a high proportion. Care must be taken, however, not to push this to the point of intolerance.

## CHAPTER XII.

## MARASMUS.

THIS condition is one that has been variously known as marasmus, arthrepsia and simple atrophy. Clinically it represents an extreme state of malnutrition following prolonged digestive disturbances, or the child may have ceased to gain in weight upon weaning and have no marked digestive disturbances other than the failure to gain in weight. The usual history of these cases is "since weaning, everything has been tried, including milk modifications, proprietary foods and condensed milk and nothing has seemed to agree with the infant." As a matter of fact the first inception of marasmus is due, in the large majority of cases, to ignorance in handling after the necessary or unnecessary weaning. The most frequent error which I observe in histories is in giving too strong dilutions of cow's milk or too large feedings. It is most frequently seen before the ninth month although a not inconsiderable number of cases occur during the last of the first year and even the first half of the second year.

Marasmus is characterized primarily by wasting to such an extent that a child of nine months may weigh little more, if any, than it did at birth.

The infant gives one the impression that the skin is hanging in folds on a skeleton, the fontanel is sunken, abdomen abnormally distended showing thin walls with the veins prominently outlined, the cry is more like a feeble whine. All of these conditions, as intimated above, may develop without any apparent digestive disturbances such as diarrhea or vomiting although constipation is quite common. On the other hand there may be occasional outbreaks of both vomiting and diarrhea. It is essentially a condition of the poorer classes in crowded tenements and institutions which are overcrowded and do not furnish a sufficient amount of fresh air for infants or a sufficient number of nurses to care for them. It is occasionally, however, seen among the well-to-do. It furnishes us with a serious problem both from the standpoint of prevention and of cure and yet, if properly handled, there are few conditions of child life which furnish a better opportunity for more brilliant results.

**Treatment.**—The most essential factor in the treatment of marasmus is prophylaxis. Maternal feeding is an essential in its prevention. To this end mothers in the poor sections especially should be educated to nurse their infants, not only from the importance to the infant itself, but from the standpoint of economy. If they can once be shown that breast milk is far cheaper than even the cheapest of cow's milk, we can impress the importance of this matter upon them. Next to this in importance is the proper use of *pure milk.*

In institutions where marasmus is exceedingly common, a sufficient amount of fresh air, out-door air where possible, proper ventilation when the infant cannot be out-doors, and a wet nurse will do much toward the prevention of the development of marasmus. As is well known, it is of common occurrence in institutions, but above all, sufficient individual care of the infant is important. In the average institution there is one nurse to about ten infants. It is impossible for these infants to be cared for properly under such circumstances.

In handling the marasmus infant from a corrective standpoint it is frequently necessary to deal with them as if they were premature. The temperature being often subnormal we place them in the basket or bassinet as described in the chapter on premature infants with artificial heat and premature garment as also described. Where the wet nurse is available, it is pre-eminently proper to secure her services; where she is not available, we handle this infant as described under difficult feeding cases, that is, commencing with a food low in proteid and fat, but rather high in carbohydrate since these cases not only need the heat producing material but take carbohydrate unusually well and assimilate it quite promptly. After being sure that a tolerance for fat and proteid has been established we gradually increase these two until a reasonable formula for a child of their age is being taken. I believe that far more is accomplished through this means than any other. However, the followers of

Finkelstein claim brilliant results from the use of Eiweiss-Milch and I have seen occasional cases where good results were obtained, but find better results in the digestive disturbances during the second year than the marasmus of the first year. The mistake has been made in not giving carbohydrate while Eiweiss-Milch is being administered until the stools have become pasty. Three per cent of malt sugar should be administered from the first, afterwards running up to as high a per cent as the child will take. The method of preparation of Eiweiss-Milch will be found in the appendix.

## CHAPTER XIII.

## INFECTIOUS DIARRHEA.

BY the term "infectious diarrhea" is meant that group of diarrheas which is caused by infectious organisms. This has been proven in certain instances by laboratory experiments, while in other cases it is assumed from the clinical manifestations. These diarrheas are not essentially food outrages though, of course, food outrages may precipitate the disturbance by lowering the digestive power of the intestines thus affording infectious organisms a suitable culture medium.

This form of diarrhea may occur at any time of the year and among any class of people, though it is far more common among the poor than among the well-to-do and its greater frequency during the hot months has led to the term "summer diarrhea." This type of diarrhea is familiar to all who deal with children hence various manifestations and variations of type will be only briefly outlined. The onset is usually sudden though it may be gradual; the intestinal symptoms predominate if sudden; gastric symptoms are frequently present and occasionally predominate. There may be colicky pains in the abdomen, or aching limbs or a feeling of malaise before the appearance of the diarrhea

though in the majority of instances these symptoms are absent. The average case commences with loose bowels which are at first fecal and may or may not contain blood or undigested food. On the second day the stools are very foul and green; streaks of blood may appear at this time, but more frequently the blood and mucus appear the third day. From this time on, the blood and mucus predominate interspersed with occasional greenish fecal passages. Macroscopic pus is usually present after four or five days but it can almost always be demonstrated under the microscope earlier. There are also cases in which membrane is present and occasionally to such an extent as to be gangrenous in which event there is an exceedingly foul odor; under these circumstances, the odor may be little worse than disagreeable. The number of stools varies from five or six in twenty-four hours to twenty-five or thirty in severe cases. Tenesmus is frequently a distressing symptom. The temperature is rarely high in typical cases ranging from 100 to 102 at first and falling rapidly with the appearance of blood and mucus. Mild cases may be reasonably near recovery by the end of one week while the average case lasts from two to three weeks. A case of even moderate severity may last, with remissions, from two to three months being relieved finally only on the advent of cool weather. Of course death may occur in prolonged cases of moderate severity from exhaustion, the child lapsing into a stuperous condition with marked asthenia

closely resembling what is known as the "typhoid state." The prostration is usually pronounced and loss of weight is rapid, both of these depending in large measure on the severity of the attack. Variations from typical cases are numerous and a few will be cited.

The onset may be so violent as to be best described as explosive. In such cases the temperature is apt to be higher than the average case, reaching as high as 105 or 106, the stools being bloody almost from the first and exceedingly frequent. In instances of this sudden onset vomiting is not unusual and in such cases the prostration is profound and appears early, loss of weight is so rapid as to be apparent in a few hours, the eyes and abdomen are sunken, though rarely the latter may be distended. The suddenness and violence of these cases suggests the theory of heat stroke very strongly. As a rule diarrhea is so pronounced and prostration so rapid in its increase that death may take place before the appearance of blood in the stools.

A number of these cases start with constipation which is so persistent that it is with great difficulty that we secure a movement at all. There is apparently toxic paralysis of the bowels and when they are finally evacuated the stools are exceedingly foul, blood and mucus being present from the first. The temperature in such cases is uniformly high until full evacuation of the intestines is se-

cured. In this type an onset with convulsions is occasionally met with.

Some cases of infectious diarrhea respond quickly to treatment while others in spite of proper treatment die early. If the onset is violent emaciation is apt to be pronounced at once, if, on the other hand, the onset is gradual, emaciation may be slight, some children passing through the whole summer with surprisingly slight loss of flesh. The type varies with different years, during some years there is marked tendency to enlargement of the liver, which is, however, by no means constant. These diarrheal conditions are responsible for a very large per cent of infant mortality and a satisfactory etiology has not as yet been worked out, although certain factors are well recognized as playing important parts.

Infectious diarrhea is exceedingly rare among breast fed babies being most commonly observed among bottle fed babies during the first year. There is a marked diminution among the number of cases after the eighteenth month. A few cases occur among the well-to-do but by far the greater number are found among the poor. It is essentially a disease of the summer months though it is occasionally met with during other seasons of the year. Certainly along the Atlantic seaboard heat plays a very important part in the etiology. I designate Atlantic seaboard specifically because the hot weather incidence is not so marked on the west coast, while the intense heat of the prairie region

west of the Mississippi has apparently little effect. This brings, however, forcibly to our attention the question of "relative humidity," the east coast having a high relative humidity while west of the Mississippi, generally, the humidity is quite low. A temperature of 90 degrees with relative humidity of 80 degrees is almost unbearable in the east, while in the west a temperature of 110 or 115 will not be uncomfortable; it will be found, however, that in regions of the west where this intense heat prevails the relative humidity is frequently as low as 8. This suggests strongly that radiation, or, rather, lack of radiation, has much to do with the incidence of these bowel disturbances.

I have studied this question closely for a number of years and am firmly convinced that the subject of radiation furnishes us a fertile field of investigation.

Overcrowding in the badly ventilated houses of the poor where the temperature is often from 5 to 10 degrees higher than out of doors together with too heavy clothing are important causative factors.

The question of milk supplies has received much investigation and while unclean milk undoubtedly causes many cases of diarrhea, Park and Holt have shown very clearly that this source of infection has been greatly overestimated. Until quite recently no very satisfactory conclusion has been reached from the study of the bacteriology of this disease. During the past three years, however, important advances have apparently been made in the study of

intestinal bacteriology. Excellent work has been done by Kendall and Smith on the Boston Floating Hospital. They found that, etiologically, there are three groups—those caused by the dysentery bacillus, those caused by the gas bacillus, and those caused by other organisms of which the most important are the streptococci, the colon bacillus and the bacillus pyocyaneus. Clinically, the disease caused by any of these groups is indistinguishable but, from a therapeutic standpoint, it is exceedingly important that they be distinguished. For practical and therapeutical purposes we may consider the gas bacillus in a class by itself while the dysentery bacillus group may include also all the other organisms mentioned above. "The dysentery bacillus, the colon and streptococci are facultative and thrive on either carbohydrate or protein." They produce harmless products from carbohydrate and toxic from protein. However, they act upon and use up the carbohydrate material before they attack the protein when both are present in the medium in which they are growing (intestines) and the products resulting from the breaking down of the carbohydrate material, when produced in sufficient quantities have an inhibitory action upon the dysentery bacillus. On the other hand, the gas bacillus grows luxuriantly in the presence of utilizable carbohydrate while lactic acid inhibits its growth. An accurate determination of the type of organism which is responsible for the particular case of diarrhea requires elaborate laboratory methods. A

simple means, however, is as follows: "A small portion of the stool is added to a test tube of milk, the infected tube is then gradually brought to the boiling point of water in a water bath and kept there for three minutes. In this way all bacteria not in the spore state are killed and the development of whatever spores may be present into vegetative cells is unrestrained by the presence of non-spore-forming organisms. The tube is then incubated at body temperature for from eighteen to twenty-four hours. When the gas bacillus is present the casein is largely dissolved; the residual casein is somewhat pinkish in color and filled with holes; the odor of the culture is like that of rancid butter. Gram-stained preparations made from milk show rather thick, short Gram-positive bacilli with slightly rounded ends." The therapeutic test may be made by selecting either a carbohydrate or a protein food and watching the results. If the symptoms become worse, we are dealing with the opposite microörganism and the food must be immediately changed. If the symptoms become better, we are presumably on the right track.

*Treatment.*—The treatment of this disease is both prophylactic and curative. The prophylaxis consists first of all in educating people in the care of infants. This can be best done in crowded centers through visiting nurses who can go into the home and teach.

With the first warm days of summer the clothing should be lightened especially during the in-

tense heat of the middle of the day and the child should be allowed to go with nothing except the diaper and frequently it is wise to remove this also. Infants should be kept out-of-doors in hot weather; frequent bathing during the day and where practicable trips to the seashore or on a steamer all day where there is a good breeze (in sections where this cannot be done a visit to a higher altitude may be substituted), go far towards preventing trouble. When the milk supply is uncertain, boiling is a good precautionary measure.

I know nothing that can be depended on to spread the disease better than a lack of care of the soiled diapers. These should be kept covered at all times and particularly during the summer they should be placed in a solution of bichloride of mercury and kept there until they can be washed. They should never be allowed to stand uncovered and exposed to flies, which spread the disease rapidly.

The medical treatment consists primarily in clearing the intestines of all food refuse by means of a dose of castor oil. This is decidedly more efficient and less drastic than any other purgative. A prompt withdrawal of all food, especially milk, until the intestines are thoroughly freed from the products of indigestion is necessary. The lower bowel should be irrigated once with a simple saline solution. Boiled water alone should be given for the first twenty-four or forty-eight hours and should be given in abundance. This is exceedingly important since a supply of fluid to the patient is a

positive necessity. As much water must be administered as would be taken in the form of nourishment. After this is done, a cereal water such as barley, given alone at first and then with about five per cent of milk or malt sugar, the sugar supplying some of the needed nourishment. In older children we may then begin to give zweibach or toast. If the disease is of the violent type we may begin with barley water which may be sweetened with milk or malt sugar, or, if this is inadvisable, with saccharine. Weak chicken broth may be given (this contains little or no nourishment but induces the patient to take water); no beef juice, beef extracts or albumen water should ever be given in these cases. If the patient does not take enough liquid, especially in severe cases, it may be necessary to administer salt solution subcutaneously. Bowel irrigations are advocated by some using salt solution or boric acid with a fountain syringe hung not more than two feet above the child's hips and with a soft rubber catheter. One irrigation a day is usually sufficient, certainly not more than two a day should be given nor should this be kept up too long as they may perpetuate a catarrhal proctitis.

My own treatment differs somewhat from this procedure. I usually give one good flushing and then administer small doses of magnesium and sodium sulphate by mouth—dose, from 1 to 5 grains each, every two or three hours according to the age of the patient, to be kept up for about a week. My

reason for managing these cases thus is because it keeps up a mild irrigation, so to speak, over the whole length of the large intestine, while at best, an irrigation merely cleanses out the lower part of the descending colon. Of course, it is supposed that this treatment tends to abstract more fluids from the patient and consequently we may have difficulty in supplying enough fluids. In my experience this has not been the case and I have found this procedure exceedingly satisfactory for several years. I never use bismuth or salol or any other supposed intestinal antiseptic. I have found all of them absolutely useless and I rarely administer opium. If tenesmus is severe and a few irrigations fail to relieve it, paregoric may be administered in a small dose *only until the tenesmus is relieved, but not enough to stupefy the patient.* This should never be given when the temperature is high or when the stools are still fecal or foul, but only when they become bloody and with mucus and, generally speaking, it is quite safe to wait at least five days, always remembering that the administering of any opiate should be discontinued as soon as possible.

In accordance with the bacteriological findings of Kendall and Smith as outlined above, the diet is very essential and, incidentally, we must return to some definite form of food as early as possible in these cases since the mistake was made for many years of starving the patient for entirely too long a time. As stated above, the bacteriology of this

condition is dependent on two types—that caused by the dysentery bacillus and such organisms as the streptococcus and colon bacillus all of which require a solution of milk sugar which must be given alone until the active symptoms are passed and temperature remains normal. The milk sugar should be given in a solution ranging from five to seven per cent in water and it is better to give frequent small amounts rather than infrequent large quantities. As a rule half as much again of the sugar solution should be given as the child normally requires fluid. We may then add a cereal such as barley water containing, as a rule, one per cent of starch. When we feel reasonably safe about the acute symptoms, we begin to add casein to the extent of .50 per cent; then .75 per cent; then 1.50 per cent—all in the form of skim milk. By this time it is probably safe to add .50 per cent of fat. If this is well borne, we gradually run up to .75 per cent, then 1 per cent, etc. After we have passed the period of usefulness of the milk sugar as a direct therapeutic agent according to the dysentery bacillus I think it much wiser to change over to malt sugar since in this class of cases malt sugar has proven eminently satisfactory in my hands in promoting a gain in weight.

Where the gas bacillus is the causative agent as already indicated we use lactic acid. This is used in the form of milk ripened with bacillus Bulgaricus and not heated. Usually we should make up a formula in these cases of 0 fat, 4 per cent milk

sugar and from 1 per cent to 2½ per cent proteid, the whole mixture to be ripened with lactic acid bacilli. Since we are using this buttermilk as a vehicle for the lactic acid bacillus it is evident that it is more valuable raw than heated. This should be kept up until active manifestations have passed, it being exactly analogous to the treatment of the dysentery type with lactose solution. When we feel that the buttermilk has served its purpose, I think it best to change rapidly from its use to a formula such as 0 fat—4 sugar—.50 proteid and then increase gradually along the lines suggested in other cases, always increasing the proteid first.

In subacute cases where blood and pus persist, injections of nitrate of silver are said to be useful but I very rarely use them. It has been my experience in this type of cases that the best we can do is to sustain the patient until the onset of cool weather. Stimulants are frequently necessary. I believe that alcohol is valueless if not positively harmful. Strychnine I use most frequently in doses of from 1/1000 to 1/100 of a grain. Caffein and camphor are the quickest and are said to act well. Caffein may be used by mouth from ⅛ to ½ grain while camphor in oil may be given in doses from 1 to 2 grains. Cool baths as well as cool fresh air are very valuable in the treatment but in instances of severe shock during a sudden onset it may be necessary to use heat. In the subacute or chronic cases, change of climate especially to a higher, dryer and cooler atmosphere is of undoubted value.

The seashore is also valuable not because it is cooler nor because there is less humidity, but because there is always a refreshing breeze which promotes radiation.

TABLE OF SOME GASTRO-ENTERIC DISTURBANCES.*

| Clinical Type. | Cause. | Injurious Food Elements. | Chief Symptoms. | Feeding. |
|---|---|---|---|---|
| Acute Gastric Indigestion. | Food injury or lowered digestive power. | Fat or casein. | Vomiting. | Low fat and casein, split proteid, alkalies. |
| Acute Intestinal Indigestion. Irritative. | Food injury or lowered digestive power. | Fat or casein. | Undigested movements, curd, masses. | Low fat and casein, split proteid, starch. |
| Acute Intestinal Decomposition. Fermentative. | a. Saprophytic bacteria.<br>b. Chemical food injury. | a. Proteid.<br>b. Fat and lactose. | Green foul movements. | a. Lactic acid milk.<br>b. Low fat and proteid with maltose. |
| Infectious Diarrhea. | a. Dysentery bacillus.<br>b. Gas bacillus.<br>c. Other organisms. | a. Proteid.<br>b. Carbohydrates.<br>c. ? | Fever, mucus and blood. | a. Lactose solution.<br>b. Lactic acid milk.<br>c. Lactose solution. |
| Chronic Gastric Indigestion. | Food injury as irritant. | Fat, casein or lactose. | Vomiting. | Low fat and casein, split proteid, alkalies. |
| Chronic Intestinal Indigestion. | Food injury as irritant. | Fat or casein. | Undigested movements, curds, masses. | Low fat and casein, split proteid, starch. |
| Chronic Intestinal Decomposition. | a. Chemical food injury. (Finkelstein)<br>b. Saprophytic bacteria. | a. Fat, lactose, salts.<br>b. Proteids. | Green foul movements. | a. Low fat, maltose, high proteid.<br>b. Lactic acid milk. |
| Infantile Atrophy. | Chemical food injury. | Fat. | Loss of weight only. | Low fat, maltose, high proteid. If possible, excessive carbohydrate. |

*Harvard Classification.

## CHAPTER XIV.

## PREPARATION OF FORMULÆ.

THE preparation of modified milk on a basis of approximate percentages has not gained the popularity which it merits because of the mistaken idea that it is difficult for the physician and impractical for the mother. The statement is often made that where a laboratory is convenient it is all very well to talk about percentages, but where the food must be prepared in the home, it is a difficult question. In the vast majority of my feeding cases the formula is prepared by the mother in the home and not in a single instance do I find any difficulty in having them prepared quite well.

The necessary equipment consists of a glass graduate measuring 16 oz. in one-half ounces; a Chapin cream dipper; round, small-neck bottles (Freeman) [the graduation on the sides of these bottles should be ignored as they are almost invariably inaccurate]; a wide-mouth pitcher; a funnel, preferably glass or white enamel; a double boiler (to be used where the milk is to be heated); milk sugar; a tablespoon; absorbent cotton; a quart bottle of milk.

In speaking of percentages, the cream referred to is 16 per cent cream, which is the gravity cream

from a quart bottle of milk. When the milk has been allowed to stand until the cream has risen, usually four hours, we can take off the upper six ounces by means of a Chapin dipper. This gives us from an average herd, 16 per cent gravity cream, i. e., cream containing 16 per cent of fat; what remains in the bottle, for all practical purposes, may be considered skim milk. The 16 per cent cream, the skim milk, the milk sugar, an abundance of boiled water, are all that are necessary to make the usual modifications of milk. The formula for average herd milk as has been given above is 4. fat; 4.5 sugar; 3.2 proteid; this latter is variously estimated at 3.2 to 3.5. Percentages worked out with these ingredients and on the basis of this formula for cow's milk, are accurate enough for all practical purposes and enable us to modify the milk from time to time so as to meet the requirements of the infant.

Average milk contains 4 per cent of fat. The visible amount of cream after standing four hours is six ounces and contains 16 per cent fat.

The various formulæ are as follows:

| | F. | S. | P. |
|---|---|---|---|
| Milk | 4. | 4.50 | 3.20 |
| Cream | 16. | 4.50 | 3.20 |
| Skim milk | 0. | 4.50 | 3.20 |
| Whey | 0. | 4.50 | .90 |
| Sugar | 0. | 100. | 0. |
| Barley water | 0. | 1.50 (carbhy.) | 0. |

(½ oz. to 1 qt.)
(4 level tablespoonfuls=1 oz.)

This equation is all that is necessary to memorize:

Let:

x=no. oz. of ingredient needed (or used).
a=no. oz. " total mixture.
y=% " element desired (or unknown).
b=% " " in ingredient used.

Therefore all that is necessary is to have an equation which is—

$$x : a :: y : b \text{ or } x=\frac{ay}{b} \quad \Big\} \quad y \text{ will be } \frac{bx}{a}$$

**Example 1.—**

It is desired to give an infant 40 oz. of modified milk in twenty-four hours (five feedings of eight ounces each) to contain—

| F. | S. | P. |
|---|---|---|
| 4. | 7. | 2. |

We first determine the number of ounces of cream (16%) required to give us the 4 per cent of fat desired. The formula will then be—

$$x : 40 :: 4 : 16 \text{ or } x=\frac{40\times4}{16}=10 \text{ oz. of gravity cream (16\%).}$$

That is, x stands for the number of ounces of cream needed; a=number of ounces of total mixture (40); y=% of element desired (4); b=% of element in ingredient used (16%).

The next step is to ascertain how many ounces of *skim milk and cream* are needed to give us the

2 per cent of proteid. The proteid is contained in both the milk and the cream; the formula, therefore, will be—

$$x : a :: y : b \text{ or } x=\frac{40\times 2}{3.2}$$

$x : 40 :: 2 : 3.2$=25 oz. skim milk and cream. Since we already have ten oz. of cream only fifteen oz. of skim milk are needed.

The next step will be to determine the per cent of sugar furnished by the milk and cream. In this step $y$ is the unknown quantity ($y$=% of element desired). Therefore the equation will be—

$$x : a=y : b \text{ or } y=\frac{xb}{a}$$

$$25 : 40=y : 4.5 \text{ or } y=\frac{25\times 4.5}{40}=2.8\%$$

This gives us the per cent of sugar contained in 25 oz. of skim milk and cream in a 40 oz. mixture. Since 7 per cent of sugar is required we need 7. minus 2.8 or 4.2 per cent additional. To secure this the equation will be—

$4 : 40=4.2 : 100$ (% of sugar in sugar) or—

$$\frac{40\text{x}4.2}{100}=1.68 \text{ oz. of sugar to be added.}$$

Since two and a half level tablespoons of sugar equal one ounce, we have to add approximately 4½ tablespoons of sugar. The completed formula will then be—

Cream ..... 10 oz.
Skim ..... 15 oz.
Milk sugar .....1.68 oz. or 4½ level tablespoons
Water ..... 15 oz.

Total ..... 40 oz.

In the total we ignore the solid sugar though as a matter of fact this takes up a small amount of water.

If in the calculation of sugar we substitute 40 for 100 in the equation the result will be level tablespoons instead of ounces.

Again, if we will bear in mind that in—

20 oz. mixture one level tablespoon adds 2% of sugar.
32 " " " " " " 1.20% " "
40 " " " " " " 1% " "
48 " " " " " " .80% " "

we will be aided materially.

**Example 2.—**

20 ounce mixture of—

| F. | S. | P. |
|---|---|---|
| 2. | 5. | 1. |

$$x : a = y : b \text{ or } x = \frac{ay}{b}$$

Amount of cream is $x = \frac{20 \times 2}{16} = 2\frac{1}{2}$ cream

Amount of cream and skim milk—

$$\frac{20 \times 1}{3.2} = 6\frac{1}{4}$$

We have already 2½ ounces of cream—

$6\frac{1}{4} - 2\frac{1}{2} = 3\frac{3}{4}$ SKM.

Percentage of sugar contained in 6¼ ounces SKM and cream=

$$y = \frac{bx}{a} = \frac{4.5 \times 6\frac{1}{4}}{20} = 1.40$$

This leaves (5.—1.50) 3.5 ounces to be added, equal approximately to 1¾ level tablespoons. Therefore we will have—

| | |
|---|---|
| Cream ..... | 2½ oz. |
| SKM ..... | 3¾ " |
| Sugar ..... | 1¾ level tablespoons. |
| Water ..... | 13¾ oz. |
| Total ..... | 20 oz. |

**Example 3.—**

30 ounce mixture of—

| F. | S. | P. |
|---|---|---|
| 3. | 6. | 1.50 |

Cream $x=\frac{30\times3}{16}$ ..... 5½ Cream .... 5½ oz.

SKM and Cream

$x=\frac{30\times1.5}{3.2}$ ...Approximately 14 SKM ..... 8½ oz.

SKM=14—5½=8½

Sugar in Milk and Cream Sugar ...3 teaspns.

$y=\frac{14\times4.5}{30}=$ ..... 2.10% Water ....15½ oz.

6—2.1=3.9 to be added Total.....30 oz.
or three level tablespoons.

When it is desired to have a formula which is a mixture of proteids that is a small proportion of the proteid of the whole milk and a larger proportion of soluble whey proteid which is more easily handled, we write the formula thus—

| F. | S. | P. |
|---|---|---|
| 2. | 7. | .90/.50 |

This means that the whey proteid is present to the

extent of .90 per cent while the insoluble proteid or casein is present to the extent of .50 per cent, the total protein being 1.40.

The indications for the use of split proteid are when the infant has a difficulty in digesting the whole proteid and yet needs as much proteid as possible; we then give the larger amount of the whey proteid. Also when a child has been taking whey and we wish to give a stronger formula than that furnished by whey alone, we add cream and skim milk as usual, continuing the whey as a diluent. The method of working out these split proteid formulæ is just as simple as the other formulæ, but will be worked out fully in order that we may understand each step thoroughly—

**Example 1.—**

20 oz. mixture (using 16 per cent cream as before) of a formula of—

| F. | S. | P. |
|---|---|---|
| 2. | 7. | 90/50 |

To find the amount of cream necessary to furnish 2 per cent fat use formula—

$$x = \frac{ay}{b}$$

in which—

x=amount of ingredient needed.
a=total quantity.
y=per cent of element needed.
b=per cent of element in ingredients used.

Then for fat—

x=amount of cream needed to give 2% fat.
a=20 oz. (total quantity).
y=2=% of fat needed.
b=16=% of fat in cream.

$$x=\frac{ay}{b}=\frac{20\times 2}{16}=2.5 \text{ ounces of cream needed.}$$

For proteid—

x=amount of SKM and cream needed to give .50 proteid.
a=20
y=.50
b=3.2 (% of proteid in milk).

Then—

$$x=\frac{ay}{b}=\frac{20\times .50}{3.2}=\frac{10}{3.2}=3.12 \text{ ounces.}$$

Then—

3.12—2.50 ounces cream (the cream also contains proteid) gives .62 ounce of SKM (for practical purposes ½ ounce). This gives a total of three ounces.

Totalling all the diluent as whey containing .90 per cent of whey proteid (WP), we have the amount of whey necessary equal to 20 (total mixture) – 3 ounces or 17 ounces of whey needed.

Now to find the amount of sugar to be added. We already have 4.50 per cent sugar derived from all the milk products. This leaves 2.5 to be added or 1¼ level tablespoons.

Formula will then be—

| | |
|---|---|
| Cream ..... | 2.50 oz. |
| SKM ..... | .50 " |
| Sugar ..... | 1¼ level tablespoons. |
| Whey ..... | 17 oz. |
| Total ..... | 20 oz. |

**Example 2.—**

30 ounce mixture of

| F. | S. | P. |
|---|---|---|
| 1.50 | 6. | .90/.40 (Total 1.30). |

Cream needed is—

$$x=\frac{ay}{b}=\frac{30\times1.50}{16}=2.75 \text{ oz. (approximately).}$$

SKM and cream needed to give .40 per cent proteid is—

$$x=\frac{ay}{b}=\frac{30\times40}{3.2}=3.75 \text{ oz. SKM and cream.}$$

3.75—2.75 oz. (cream) or 1. oz. SKM.

Amount of sugar in milk products is 4.50 per cent leaving 1.50 per cent to be added or 1 tablespoon (level).

Formula will then be—

| | | |
|---|---|---|
| Cream ..... | 2¾ | ounces. |
| SKM ..... | 1½ | " |
| Sugar ..... | 1 | level tablespoon. |
| Whey ..... | 26¼ | ounces. |
| Total..... | 30 | ounces. |

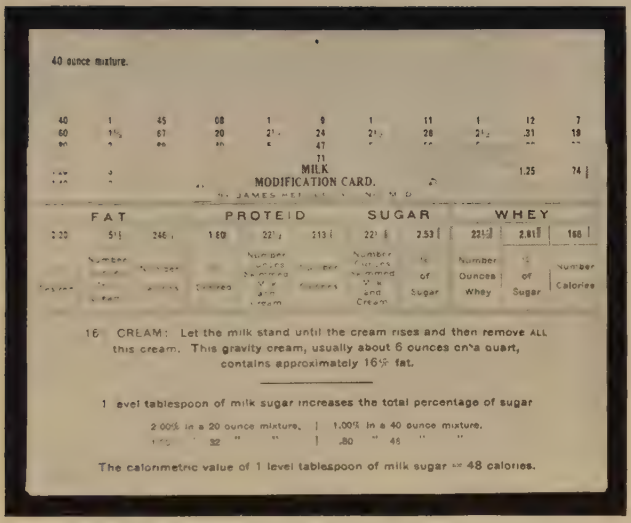
If we wish to change the percentage of whey proteid (WP) in our mixture, we need but to remember the following—

When all diluent is whey, the whey proteid is approximately ..... .90
When ¾ diluent is whey, the whey proteid is approximately ..... .75
When ½ diluent is whey, the whey proteid is approximately ..... .50
When ¼ diluent is whey, the whey proteid is approximately ..... .25

I do not think the card system for calculating these formulæ is wise for several reasons. As a rule cards are rarely accurate; they also promote laziness on the part of the physician. They are convenient, however, and some physicians may be willing to make use of the percentage method of feeding if the way is made particularly easy for them. I will describe one of these cards which appears to me the simplest. This card is exceedingly clever and was devised by Dr. James Herbert Young, of Newton, Mass.*

This card is in the shape of a celluloid envelope with various openings and contains cards with tabulated figures by which we are enabled to calculate formulæ for 20—32—40—48 ounce mixtures. If we wish a 38 ounce mixture, the idea is to make up 40 ounces and discard two ounces of the total amount. The waste is insignificant. The way to

*This card is obtainable from the F. H. Thomas Co., 691 Boylston St., Boston, Mass.



40 ounce mixture.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 1 | 45 | 08 | 1 | 0 | 1 | 11 | 1 | 12 | 7 |
| 60 | 1½ | 67 | 20 | 2¼ | 24 | 2½ | 28 | 2½ | 31 | 19 |
| | | | | | 47 | | | | | |
| | | | | | 71 | | | | | |
| | | | | | MILK | | | | 1.25 | 74 |

MODIFICATION CARD.

| FAT | | | PROTEID | | | SUGAR | | WHEY | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3.00 | 5½ | 246 | 1.60 | 22¼ | 313 | 22 | 2.53 | 22½ | 2.81 | 188 |
| | Number Ounces Skimmed Milk and Cream | | | Number Ounces Skimmed Milk and Cream | | Number Ounces Skimmed Milk and Cream | | Number Ounces Whey | Number of Sugar | Number Calories |

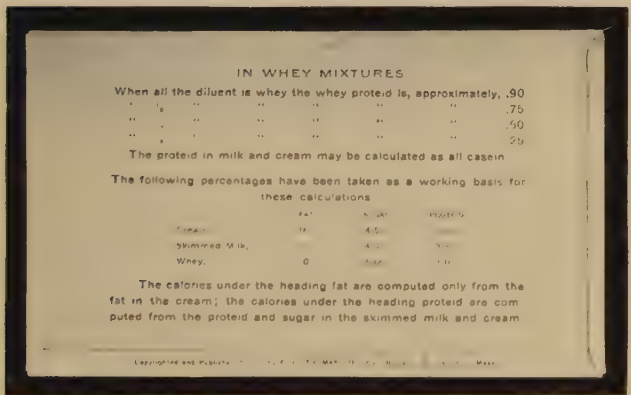
16% CREAM: Let the milk stand until the cream rises and then remove ALL this cream. This gravity cream, usually about 6 ounces on a quart, contains approximately 16% fat.

1 level tablespoon of milk sugar increases the total percentage of sugar

2.00% in a 20 ounce mixture, | 1.00% in a 40 ounce mixture.
1.50 " 32 " " | .80 " 48 " "

The calorimetric value of 1 level tablespoon of milk sugar = 48 calories.

A.



IN WHEY MIXTURES

When all the diluent is whey the whey proteid is, approximately, .90

" ½ " " " " " .75

" ¼ " " " " " .50

" ⅛ " " " " " .25

The proteid in milk and cream may be calculated as all casein

The following percentages have been taken as a working basis for these calculations

| | FAT | SUGAR | PROTEID |
|---|---|---|---|
| Cream | 16 | 4.5 | |
| Skimmed Milk | | 4.5 | 3.6 |
| Whey | 0 | 5.0 | 1.0 |

The calories under the heading fat are computed only from the fat in the cream; the calories under the heading proteid are computed from the proteid and sugar in the skimmed milk and cream



B.

Fig. 4.—Young's Feeding Card. (Obverse and reverse.)

use the card is as follows: if we wish to make up a 20 ounce mixture containing—

| F. | S. | P. |
|---|---|---|
| 1.20 | 5. | 1.60 |

we select the card for a 20 ounce mixture and withdraw it from the envelope until the figure 1.20 appears at the *first opening* in the division marked fat. We see in the *second opening* of the same division at once that 1½ ounces of cream are required. To find the proteid, we so place the card that the desired per cent of proteid is in the *first opening* of the division marked proteid, we then see in the *second opening* that 10 ounces of *cream and skim milk* are required to give 1.60 per cent of proteid in a 20 ounce mixture. We already have 1½ ounces of cream so we need 8½ ounces of skim milk. By placing the card so that 10 will appear in the *first opening* under "sugar," we see that the next opening gives us 2.25 which is the percentage of sugar derived from 10 ounces of cream and skim milk; this leaves 2.74 to be added. In a 20 ounce mixture one level tablespoon of sugar adds 2 per cent; $\frac{2.75}{2}$ gives 1 1/3 level tablespoons. The mixture would then be—

| | | |
|---|---|---|
| Cream ..... | 1½ | ounces. |
| SKM ..... | 8½ | " |
| Sugar ..... | 1⅓ | level tablespoons. |
| Water ..... | 10 | ounces. |
| Total..... | 20 | ounces. |

A little practice will make one quite proficient in the use of this card. The chief objection to it

DR L. T ROYSTER
NORFOLK, VA

Date Aug 18-15

Name Baby Smith

Age 6 mos. Weight 16½ lbs.

For F 3. S 6. P 150 Each Feeding 7

No. Bottles 6 Interval of Feeding 3½

| | oz |
|---|---|
| Cream | 8 |
| Milk | |
| Skimmed Milk | 12 |
| Milk Sugar | |
| Malt Sugar | 4½ tablespoons (level) |
| Lime Water | |
| Whey | |
| | |
| Water | |
| Boiled Water | 22 |
| Total | 42 |

| | Sun. | Mon. | Tues. | Wed. | Thurs. | Fri. | Sat. |
|---|---|---|---|---|---|---|---|
| No. Stools | | | | | | | |
| Char Stools | | | | | | | |

Fig. 5.—Author's slip for guiding mothers in home modification.

is that it has in view even number of ounces rather than exact percentages.

When it is desired to direct the feeding of an infant in a private family it is necessary first to select the formula which is thought to be proper for the individual case, such as—

| F. | S. | P. |
|---|---|---|
| 2.50 | 6. | 1.25 |

with eight bottles of five ounces each making a total of 40 ounces in the twenty-four hours. Then tell the mother how much of each ingredient is needed to give this formula. For this purpose the author makes use of the printed slip shown on p. 126, which has been filled in by way of example. On this slip will be seen space for a week's observation of number and character of stools. This furnishes all that is necessary for the average mother.

When one is first called to take charge of a feeding case the child is, of course, on some sort of mixture and it is desirable to ascertain the percentage of the various ingredients which the child is getting. To find this we have merely to make a calculation exactly the reverse of that given previously. For example, to determine the formula in the following 30 ounce mixture consisting of—

| | |
|---|---|
| Cream (16%) ..... | 4 ounces. |
| SKM ..... | 8 " |
| Sugar ..... | 3 level tablespoons. |
| Water ..... | 18 ounces. |
| Total ..... | 30 ounces. |

The ratio is—

$x : a = y : b$ as before with the same value.

But in this instance y is the unknown quantity, therefore

$$y = \frac{bx}{a}$$

First step is to determine per cent of fat in 4 ounces of cream—

$$y = \frac{bx}{a} = \frac{16 \times 4}{30} = 2.13\%.$$

Second step is to determine proteid in 12 (4+8) ounces C & SKM—

$$y = \frac{bx}{a} = \frac{12 \times 3.2}{30} = 1.28\%.$$

Third step to determine sugar in milk and cream—

$$y = \frac{bx}{a} = \frac{12 \times 4.5}{30} = 1.80\%.$$

Fourth step to determine sugar per cent in three level tablespoons—

$$y = \frac{bx}{a} = \frac{3 \times 40}{30} = 4.$$

(As stated before, to substitute 40 instead of 100 in equation deals with level tablespoons instead of ounces. Otherwise it would be necessary to reduce 3 measures to ounces first.)

Therefore the formula will be—

| F. | S. | P. |
|---|---|---|
| 2.13 | 5.8 | 1.28 |

In dealing with whole milk mixtures we merely have to bear in mind the formula of cow's milk—

| F. | S. | P. |
|---|---|---|
| 4. | 4.50 | 3.20 |

and the amount of dilution. For example, if we have a dilution of half water and half cow's milk the formula will be—

| F. | S. | P. |
|---|---|---|
| 2. | 2.25 | 1.60 |

Or if ¼ milk and ¾ water—

| F. | S. | P. |
|---|---|---|
| 1. | 1.12 | .80 |

Or if ¾ milk and ¼ water—

| F. | S. | P. |
|---|---|---|
| 3. | 3.36 | 2.40 |

and so on. The amount of sugar to be added would then be in accordance with the rule as stated before, that one level tablespoon of milk sugar increases the total percentage of sugar—

2% in a 20 ounce mixture,
1.33% " " 30 " "
1% " " 40 " "

In calculating the formula for the mixture it is in accordance with the rule already given.

For example—40-ounce mixture containing—

Whole milk ..... 15 ounces.
Milk Sugar ..... 4 level tablespoons.
Water ..... 25 ounces.
Total..... 40 ounces.

The formula will be—

$$x : a = y : b \quad \frac{15 \times 4}{40} = 1.50 = \text{Fat}$$

Y being unknown—

$$y = \frac{bx}{a} \qquad \frac{15 \times 3.2}{40} = 1.20 = \text{Proteid}$$

$$\frac{15 \times 4.5}{40} = 1.70 \text{ (Sugar from milk)}$$

$$\frac{4 \times 40}{40} = 4\% \text{ added by 4 teaspns.}$$

Formula would be—

1.50 5.70 1.20

If we have a mixture made up from so-called top milk such as simple dilutions of 1/3 or upper ½, we will find (in appendix) that the upper 1/3 of a quart bottle has about 10 per cent cream and the upper ½, 7 per cent. Therefore, the whole formula of upper 1/3 of quart bottle will be—

10. 4.50 3.20

and of upper ½—

7. 4.50 3.20

Therefore a mixture made of upper 1/3 dilution contains—

| | |
|---|---|
| Upper 1/3 milk.... | 8 ounces. |
| Milk sugar ..... | 3 level tablespoons. |
| Water ..... | 22 ounces. |
| Total..... | 30 ounces. |

will contain—

| | | |
|---|---|---|
| 2.66 | 5.20 | .85 |

## CHAPTER XV.

## CALORIC NEEDS OF INFANTS.

THE calculation of the caloric requirements of infants has received much attention at the hands of investigators. As a result of this, a so-called caloric method of feeding has arisen; while by some infant feeders the caloric value of various food ingredients has been almost ignored. As a method of feeding or of expressions of food dilutions, I do not employ nor approve of the calculation. As a check on our work in estimating whether an individual infant is getting food far below or in excess of its needs it is of very great value. An occasional calculation of the caloric value of the food of a healthy infant will aid us at times, if found to be too high, in preventing a digestive disturbance by reducing the ingredients. In feeding delicate and especially marasmic infants this procedure is invaluable.

If, for example, we find that fat is causing a disturbance in the digestion and yet the infant needs all the food it can secure, by calculating the caloric needs we may know exactly what percentage of proteid or sugar to give in order to make up the deficiency of fat.

From careful observation and calculation it has

been found that the needs of an infant differ in food value according to age and state of health. Thus it has been determined that the caloric needs of infants are about as follows:

| | | | |
|---|---|---|---|
| For first three months..... | 100 | calories per | kilo. |
| | 45 | " " | lb. |
| From three to six months..... | 90 | " " | kilo. |
| | 40 | " " | lb. |
| From six to twelve months..... | 80 to 75 | " " | kilo. |
| | 37 to 34 | " " | lb. |

These are calculated for a normal average child at rest. Very active infants require a higher caloric value as do those much below average weight as a result of exhausting or constitutional disease. Infants in such a condition may require as high as 150 calories per kilo. It has been my experience, as well as that of physicians living further South, that the warmer the climate the lower is the caloric requirement.

Only a few calculations are necessary to determine the number of calories in a given formula. It is always well to bear in mind two simple equations—the total number of calories in twenty-four hour quantity divided by the weight in kilos is equal to the "energy quotient." The "energy quotient" is the number of calories per kilo required by an infant of a given age. If the total number of calories in twenty-four hour quantity of food be divided by the weight in pounds, we have the "pound equivalent" for the energy quotient. (See table above.) It is obvious, therefore, that the "en-

ergy quotient" multiplied by the weight will give us the number of calories required in the twenty-four hours.

So much for the needs of the infant. The next step is to know how to calculate the total number of calories from the formula or mixture. This may be done, of course, by adding up the caloric value of each ingredient used. Thus one ounce of 16 per cent cream is equal to 54 calories while the caloric value of one ounce of skim milk is 9, and one level tablespoon of sugar is equal to 48 calories. There is a simple method of calculating the formulas as a whole, which expressed in terms of an equation is—

$$2F + S + P \times 1\frac{1}{4}Q = \text{total calories.}$$

F, S and P stand for the percentage of fat, sugar and proteid while Q stands for the total quantity. Therefore, if we wish to determine the number of calories in a mixture containing 40 oz. of—

| F. | S. | P. |
|---|---|---|
| 4. | 6. | 2. |

we have—

$$8 + 6 + 2 \times 1\frac{1}{4}\ (40) = 16 \times 50 = 800 \text{ calories.}$$

It is sometimes desirable to calculate the values in calories of the fat separately from the sugar and proteid. To secure this, we have—

$$Q \times 3 \times \%F = \text{Fat calories.}$$

and—

$$Q \times 1.3 \times \%S \ \&\ \%P = \text{calories of sugar and proteid.}$$

Thus in a 20 ounce mixture of—

| F. | S. | P. |
|---|---|---|
| 3. | 6. | 1. |

we have—

$20 \times 3 \times 3 = 180$ calories of fat.
$20 \times 1.3 \times (6+1) = 186$ calories from sugar and proteid.
$180 + 186 =$ total calories.

These equations have been determined with a view to convenience and rapid calculation and not absolute accuracy. The values are near enough for practical purposes.

## APPENDIX.

### Human Milk.

Formula—

| F. | S. | P. |
|---|---|---|
| 4 | 7 | 1.50 |

1 ounce contains 21½ calories.

Cow's milk from average herd.

Formula—

| F. | S. | P. |
|---|---|---|
| 4. | 4.50 | 3.20 |

1 ounce contains 19.38 calories.

PERCENTAGE OF FAT IN PART REMOVED FROM QUART BOTTLE STANDING FOUR HOURS.

| UPPER | PER CENT FAT | CAL. PER OZ. |
|---|---|---|
| 2 oz. | 24 | 69.6 |
| 3 " | 22.5 | 65.9 |
| 4 " | 21.4 | 63.1 |
| 5 " | 19.2 | 57.6 |
| 6 " | 16.8 | 50.6 |
| 7 " | 15 | 47 |
| 8 " | 13.3 | 42.9 |
| 9 " | 11.5 | 34.8 |
| 10 " | 10.5 | 35.9 |
| 12 " | 9 | 32.1 |
| 14 " | 7.8 | 29.1 |
| 16 " | 7 | 27.1 |

| UPPER | PER CENT FAT | CAL. PER OZ. |
|---|---|---|
| 18 " | 6.33 | 25.4 |
| 20 " | 5.8 | 24.1 |
| 22 " | 5.4 | 23.1 |
| 24 " | 5 | 22.1 |
| 28 " | 4.7 | 21.4 |
| 30 " | 4.3 | 20.4 |
| 32 " | 4 | 19.6 |

### Barley Water.

Add one-half ounce barley flour to 32 ounces water; cook 20 minutes; add sufficient boiled water to supply amount lost through evaporation; strain through several layers of muslin which has been scalded; add pinch of salt.

This contains 1.50 per cent starch and possesses a caloric value of 1.8 calories per ounce. Four level tablespoonfuls of barley flour equals one ounce.

### Whey.

Add four teaspoonfuls of pepsin (Fairchild's most satisfactory) to one quart of milk which has been heated to 100 degrees F. and stir for a moment. Let this stand at 100 degrees until the curd has formed (about one-half hour is required); break up the curd thoroughly with a fork (which is better than a spoon for the purpose); filter the curd from the whey through muslin; it is well to hang this up for half an hour and secure the entire amount of whey. The whey should then be brought to a boil to destroy the ferment which would sour any other milk which it might be de-

sired to add. The formula of whey will vary according to whether it is made from whole milk or skim milk. If made from whole milk the formula will be approximately—.90 fat, 4.50 sugar, and .90 proteid (whey proteid). If made from skim milk the formula will be—0 4.50 .90. Whey contains on an average from 4 to 6 calories per ounce.

**Eiweiss-Milch, the Casein Milk of Finkelstein.**

The proportion of this is made essentially in the same way except that in this instance the whey is disregarded and the curd is retained. The curd is removed from the muslin and is pressed through a thin sieve two or three times by means of a wooden mallet or spoon. One pint of water is added to the curd during this process. The mixture should now look like thin milk and the precipitate must be very finely divided; to this mixture one pint of buttermilk is added. This is done for three reasons—first, on account of the small amount of milk sugar it contains; second, to obtain the good effects of the lactic acid; third, because buttermilk can be kept for a long time.

The formula for casein milk is approximately 2.5 fat, 1.5 sugar and 3 proteid; one ounce contains about 11.5 calories.

In administering this milk it is well to add at least three per cent of malt sugar. It may be gradually increased as deemed necessary even reaching eight or nine per cent of added sugar. Casein milk must be given in very small quantities in acute

conditions and should under all circumstances be administered in small amounts to commence with. As the case progresses it may be increased to the same amount the child would take of any other milk mixture.

### Condensed Milk.

The average condensed milk is made by evaporating ordinary cow's milk to about one-half, usually adding enough cane sugar to bring the total sugar content to 55 per cent. From five brands of condensed milk I have made an average formula which is as follows—

| F. | S. | P. |
|---|---|---|
| 8.4 | 53.3 | 7.9 |

The most frequent dilutions of condensed milk are—

1 to 20
1 to 16
1 to 12
1 to 10

Formula of each of these will be respectively—

| F. | S. | P. |
|---|---|---|
| .42 | 2.50 | .39 |
| .52 | 3.14 | .48 |
| .70 | 4.19 | .65 |
| .84 | 5.03 | .79 |

The caloric value of one ounce of condensed milk is 97.5.

### Malt Sugar.

When we speak of malt sugar in milk modifications we refer to the mixtures of Dextrin and Maltose

which are the only available ones on the market. The analysis of these varies within the following limits—

Maltose—52% to 60%
Dextrin—45% to 30%

### Peptonization.

Use the Peptonizing Tubes of Fairchild which consists of powdered extract of pancreas and bicarbonate of soda. Dissolve this powder in about four ounces of water, add this to a pint of milk and stir until thoroughly mixed. Place the bottle containing milk and powder in a pan of water at about 115 degrees, keep this bottle in the water bath for from five to twenty minutes according to the length of time we wish to peptonize the milk, twenty minutes giving complete peptonization. Bring the milk rapidly to a boil to check the process, and then place on ice. Peptonized milk may be modified in the same manner as raw milk.

### Buttermilk.

Strictly speaking, this should be known as ripened milk and not buttermilk. The process which is employed in the milk laboratories which usually supply infants' hospitals is entirely too complicated for home use. I have therefore devised a method which for practical purposes has served me quite well.

This buttermilk is made either with the tab-

lets containing bacilli Bulgaricus or from the liquid culture. When made from the liquid culture the process is shorter because no time is then required for the bacilli to grow, whereas with the tablets, time must be given for the bacilli to culture themselves in the milk medium. The druggists are supplied with both preparations. I will, therefore, give a routine for the making up of one quart of ripened milk which is as follows:

24 oz. of skim milk.
8 oz. of water at 120° F.
1 tube of bacilli Bulgaricus.
15 gr. salt (common salt).

The tablet and the salt are mashed up together and added to the water, when dissolved; this water in turn is added to the twenty-four ounces of skim milk; this is stirred and shaken thoroughly, then set aside in a dark place for twenty-four hours at a temperature of approximately 75° F; it is then set on ice for thirty-six hours. It is preferable to strain it through a fine mesh sieve as this avoids the lumpy appearance.

In the place of one tablet we may employ the liquid culture using the contents of one of the small commercial bottles. Care must be taken to use a sufficient quantity of the bacilli; it is immaterial if we use an excess.

When buttermilk is to be used in connection with the precipitated casein (Eiweiss-Milch) tablets, I think, are sufficient. When buttermilk is to

be used for the therapeutic value of the bacilli, I believe the liquid culture is preferable.

### Batter Bread (Spoon Bread).

1 cup corn meal (water ground).
2 cups sweet milk or water.
2 eggs.
1 level teaspoon baking powder.
¼ teaspoon salt.

Beat eggs slightly, add meal sifted with baking powder and salt, add milk slowly, stirring constantly. Heat in pan one tablespoon butter or lard, when boiling hot, pour in batter and cook in quick oven until brown.

# INDEX